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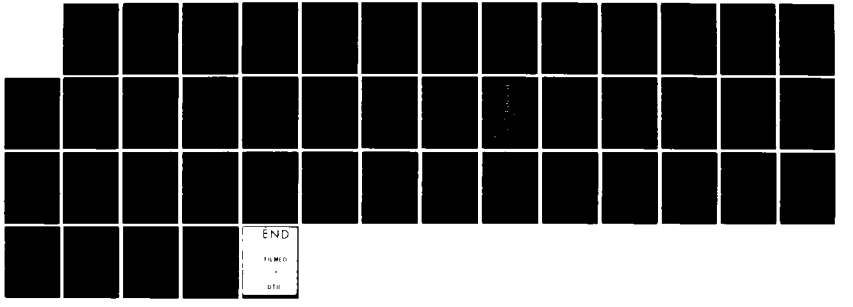

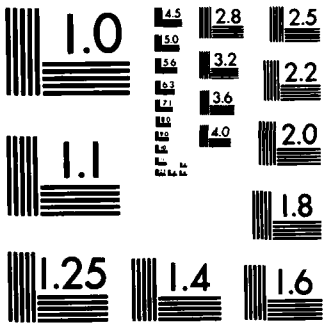

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FINAL TECHNICAL REPORT

# SLEEP LOSS EFFECTS ON CONTINUOUS SUSTAINED PERFORMANCE

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The ability to sustain continuous performance for up to 42 hours was studied with 30 subjects. During each 10 minutes, subjects performed a tracking task, a pattern memory task, an addition task, and provided subjective ratings on sleepiness and attention-fantasy scales plus a brief written description summarizing their thoughts. Of the 10 subjects required to work alone, 4 did not complete the 42 hours and 9 experienced "psychological events" such as hallucinations, visual illusions, and disorientation. Of the 20 subjects who

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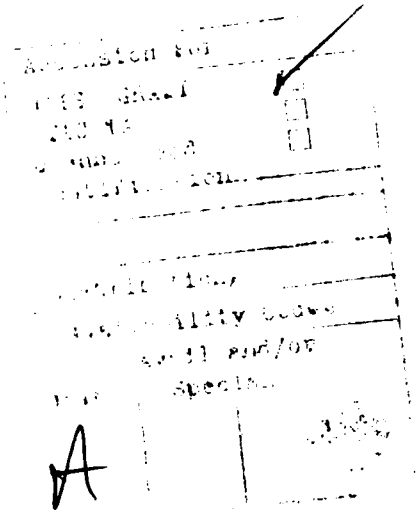
began the 42-hour task in pairs, 5 did not complete the 42 hours and 13 experienced similar psychological events. The percentage who did not complete the 42 hours of study and the incidence of psychological events were not significantly different for subjects working alone and in pairs. Performance results were very similar. No significant relationship of psychological events to any of our performance measures was demonstrated. These results indicate that continuous sustained performance in itself causes rapid deterioration of performance and psychological disturbances, regardless of the presence or absence of social contact.



## Introduction

In previous research, we found that 3 out of 10 subjects who were asked to sustain continuous performance for up to 42 hours could not complete the study and 8 out of 10 experienced disturbing psychological events such as visual illusions, hallucinations, derealizations, and distortions (Mullaney, Kripke, and Fleck, 1981). All 20 subjects who were given either one 6-hour or six 1-hour rest periods were able to complete similar protocols, and they experienced fewer psychological events.

This previous study showed that continuous sustained performance produces a more rapid deterioration of performance and more disturbing psychological events than would be expected from 42 hours of sleep deprivation alone. Although these initial subjects were not explicitly isolated from the external environment, interpersonal communication with subjects was minimized to prevent distraction. The mental disturbances which our subjects experienced seemed to result from a narrowing of attentional focus onto monotonous, repetitive inputs in combination with a degree of social isolation and sleep deprivation. Subjects seemed to experience relief after brief contacts with the experimenters. Thus, our initial study raised a question whether social contact could ameliorate the performance deterioration and psychological disturbances caused by sustained performance.

In order to measure the influence of social contact upon performance and upon the occurrence of psychological disturbances during sustained continuous performance, we have now tested 30 additional subjects for 42 hours. Of these, 10 worked alone and 20 worked in pairs. We employed three of the four performance measures used previously. To more closely monitor psychological processes, we also collected written descriptions summarizing subjects' thoughts every 10 minutes. This new testing protocol focused on two issues. First, we were able to

more closely define the relationship between sleepiness, performance on our tasks, and the occurrence of such psychological events as hallucinations and visual distortions. Second, we were able to measure the effectiveness of enhanced interpersonal contacts in preventing mental aberrations during continuous sustained performance. Conversely, the study also reflected the impairment which interpersonal contacts might produce due to distraction of attention.

## Methods

### Subjects

Subjects were 30 male volunteers, mostly university students, recruited from advertisements in a campus newspaper. Their ages ranged from 18 to 35 with a mean of 21.1 years.

### Protocols

Potential subjects were screened by interview for suitability and motivation. All subjects completed written informed consents. After instruction, they were allowed to practice the performance tasks for 30-40 minutes on a day prior to the study. Subjects also completed short-form MMPIs. Subjects with invalid MMPI profiles or profiles suggesting a predisposition to psychotic thinking were excluded. Subjects were told that even though they were free to drop out of the study at any time, we preferred that they complete the protocol and attempt to maintain a sustained high level of performance at all times. Subjects were further instructed that, although we discouraged breaks, a 10 or 20-minute break if necessary was preferable to dropping out of the study. Subjects were paid $2.50 per hour for each hour of participation. In addition, to enhance motivation and compliance, subjects were paid up to an additional $2 per hour depending on

their performance and contingent upon their completion of the study.

Each study began with a 6-hour sleep period, which was chosen to be as close as possible to the subjects' usual bedtime. Right and left hemisphere parieto-occipital EEG, submental electromyogram (EMG), and activity from the dominant wrist were recorded during sleep. Sleep records were later scored for sleep stages using Rechtschafen and Kales (1968) criteria. Subjects were awakened usually between 0500 and 0600 (mean time= 0540) and immediately commenced performance testing.

Studies with single subjects (Group I) and studies with paired subjects (Group II) were alternated. Subjects were recruited not knowing to which group they would be assigned. One pair of subjects in Group II were acquainted with each other from the student dormitory where they resided. All other pairs were strangers before the study. These experiments were completed from November of 1981 through April of 1982.

Subjects worked in a well-lighted attractive 3x3.5m room. They were intermittently visited by research staff to attend to subjects' needs and to repair occasional equipment problems. Subjects did not wear wrist watches, but they were not otherwise isolated from time cues such as hallway noises and a hallway clock. They were permitted to walk across the corridor to use the restroom. Snack food and non-caffeinated beverages were available ad lib, but the performance tests were not discontinued for eating, drinking, or restroom trips.

Tasks

Performance tasks were presented using an Apple II microcomputer. The sequence of task presentation is diagrammed in Figure 1. Three performance tests were used: 1) A 2.5-minute tracking task displayed a small randomly-moving target

on a video monitor screen which also displayed a stationary grid. The simulation resembled a pilot guiding a moving target into his gun sights. The subject was required to position the target in the center of the stationary grid by use of control stick, at which time he could score a "hit" on the target by pressing a "trigger" button. A simulated explosion when the target was properly tracked and hit provided immediate feedback. The number of "hits" was tabulated by the computer. This task was self-paced. Instructions to subjects were to score as many "hits" as possible. The hit score determined the bonus earned. 2) A visual pattern memory task was presented for 2.5 minutes. A randomly-generated 5X5 matrix of 25 rectangles (each either white or black, measuring 2.6 X 3.7 mm) was displayed on the video monitor screen for 3 seconds. After this initial pattern disappeared from the screen, a second and a third pattern were sequentially displayed, either of which might be identical to the original pattern or randomly vary by 1 of 25 squares. The subject indicated by pressing the appropriate key if the second, the third, or neither copy was identical to the first pattern. This task was experiment-paced, and 3.2 seconds were allowed for responses. Subjects received immediate feedback on whether their identifications were correct or wrong. 3) The subject was required to add two randomly-generated 3-digit numbers (presented on the monitor), then add 7, and enter the 3-digit sum on a numeric keyboard. The task duration was 2.5 minutes. The time allowed for responses within the task was limited, and this limit was varied adaptively in proportion to performance success to create time pressure. Thus, this task was experimenter-paced although adaptive to an individual's ability, and it tended to demand maximal performance speed. Subjects were given immediate feedback regarding "correct" and "wrong" additions. Speed and accuracy were both emphasized in this task. Earned bonuses depended on the number of correct additions.

At the end of each task, the video monitor displayed summary feedback on performance in the form of a statement of the amount of bonus money earned during the 2.5-minute task interval. Thus, the performance tests were framed as a repetitive series of tasks where correct performance was rewarded by money. The scoring system severely penalized failures to respond to the task presentations, so that inattention or sleep were heavily penalized, whereas errors representing continuing effort were less heavily penalized. In this way, the reward system was able to elicit highly-motivated effort from most subjects.

At the end of each 7.5 minutes of testing, subjects were asked to rate themselves on Stanford Sleepiness Scale items using a linear 100-mm scale. A similar scale was used to rate degree of attention vs fantasy activity. Subjects then answered automated inquiries concerning the amounts of food and drink consumed plus whether they had used the restroom during the prior 10 minutes. Finally, summary feedback on total 10-minute performance was displayed (total amount of money earned plus a projected hourly rate). Simultaneous with the summary performance display, subjects were given a random 3-digit code number and asked to write that number onto a 5x7 card along with a brief description of "what has been on your mind" during the past 10 minutes. The code numbers were used to enable the cards to be sorted later without times cues. Subjects were given extensive coaching and practice prior to the study on writing good descriptions of mental content. Written instructions were placed in front of them during the 42-hour test period (see Appendix A).

Subjects usually completed subjective responses rapidly enough to obtain 30-45 seconds of free time to use the restroom, stretch, eat, etc. If subjects were not ready to resume their duties at the end of this time, they were penalized by the system for failures to respond. This sequence repeated itself every 10 minutes throughout the periods of performance testing, resulting in 6 scores per

hour for each performance task and each subjective measurement.

### Debriefing and Follow-up

At the conclusion of the study, subjects were interviewed. Subjects were then accompanied home. Telephone follow-up contacts were made the next day in order to assure the subjects' health. Later follow-ups were also obtained from time to time. Finally, subjects were paid to return to the lab within one week to rank order their own verbal description cards to indicate the relative daydream-like quality. The scale used is given in Appendix A. The cards were later reshuffled and again blindly rank-ordered by one of the experimenters.

## Results

### Compliance and Psychological Events

Most of the subjects completed the studies. Four of the 10 subjects in Group I and 5 out of 20 in Group II did not complete the 42-hour performance tests. One of the subjects in Group I was terminated after 36 hours by the investigators because he was experiencing disorientation, confusion, and possibly some mild hallucinations. This subject was willing and probably able to continue after talking briefly with the investigators, since his problems rapidly cleared. However, we elected to terminate this study in the interest of safety. All other subjects who failed to complete the protocol themselves elected to quit, complaining that they were too sleepy to continue, felt momentarily ill, or (in 2 cases) simply were not sufficiently motivated to continue. The frequency of subjects dropping out did not differ significantly between groups. We also reanalyzed dropout data, adding the 10 subjects studied previously (Mullaney, Kripke, and Fleck, 1981), who completed a similar though not quite identical

protocol. Thus, comparing 20 subjects working alone with 20 working in pairs, again we found no significant differences between groups in dropout rates.

As is shown in Table 1, 22 subjects reported a variety of perceptual/psychologial events, such as illusions, visual distortions, mild visual hallucinations, and derealizations. Nine of 10 subjects in Group I experienced at least one psychlogical event as compared to 13 out of 20 Group II subjects. According to a Fisher's exact test, the frequency of subjects experiencing at least one psychological event was not significantly different between groups. We also divided the number of total events which occurred per subject by the total time that the subject continued in the study to derive the number of events per hour, thus correcting for dropout effects. There was still no significant difference between groups. When the 10 subjects from the previous study were combined with Group I subjects from the present study, there was again no significant difference in occurrence of events between subjects working alone or in pairs (Table 2).

Examples of the types of illusions which were experienced included movements of the walls or parts of the room and changes in the colors of objects. Hallucinatory experiences were both visual and auditory, such as a third person appearing in the room or voices which were heard often speaking in unusual accents or languages. A number of subjects specifically described these experiences as "dreamlike" in that the setting or surrounding was at times changed, a complex story or scene developed, and at times the subject entered into the dream story. Nevertheless, in retrospect, the subjects believed they were awake during these dreamlike experiences, often continuing with their eyes open to work at the performance tasks. Occasionally, the tasks would become part of an illusion, for example, computer display numbers seemed to become pieces of cheese which one subject was attempting to fe. . to mic .ho were emerging from holes in the

floorboards. One subject experienced some magical ideas about performing the automated tasks and, in a few cases, delusions developed about various aspects of the surrounding or the experiment. Except for a single subject who remained confused for 2-3 minutes, none of these psychological events persisted at all after termination of the experiment, and no psychological disturbances were reported at any time once the subjects were escorted home and given a chance to sleep.

Because the psychological events reported by subjects were often noted in the written descriptions provided each 10 minutes, we were able to locate most occurrences of these events approximately in time. Figure 2 shows the timing of these events. The psychological events were quite scattered, although few occurred in the first 14 hours of performance. The histogram (Figure 2) suggested that events occurred earlier in subjects working alone compared to subjects working in pairs. To test this statistically, the subjects in Group I and Group II who experienced any psychological event were ranked according to the hour when the first event occurred. The subject with the earliest onset was ranked 1, the subject with the second earliest onset was ranked second, etc. According to a Wilcoxin rank sum test, the time of the first event was not significantly different between groups. Also, the number of subjects in both groups who experienced events in the first 21 hours and the number who experienced events in the last 21 hours of the study was contrasted (Fisher's exact test), but the distribution was not significantly different between groups.

Objective Sleep Measures

Although each subject was given an initial 6-hour period in order to sleep, total sleep time varied slightly from one subject to another. The mean total

sleep time for Group I was 328 and for Group II was 331 minutes, with no significant difference between groups. Also, no significant differences were found between groups in the minutes spent in any sleep stage.

Performance Data and Subjective Measures

All three performance measures plus the subjective measures of sleepiness and attention/fantasy showed consistent trends. To emphasize intra-subject trends in performance over time while minimizing the contributions of inter-subject variability, the sequential 10-minute scores for each subject were normalized (converted to z-scores). Hourly means of normalized values for each performance measure were plotted for Group I and Group II separately. The shapes of the 42-hour curves were very similar for all 3 performance measures (Figures 3, 4, and 5) and for the subjective measures (Figures 6-13).

In order to examine changes in performance and subjective measures over time and between groups, the final 42 hours of the study were first partitioned into seven 6-hour blocks of time. Means were then computed for each 6-hour period for each subject. A factorial Analysis of Variance (ANOVA) was then applied to these 6-hour means for the 6 Group I and 15 Group II subjects who completed the entire 42 hours of the study (Table 3). Significant time effects occurred for all performance measures ($p<.0001$) and for all subjective measures except feeding and restroom trips. There were no main-effect differences between Group I subjects who worked alone and Group II subjects who worked in pairs. According to the ANOVA, the only significant ($p<.05$) time/group interaction occurred for tracking. Figures 3a and 3b suggest that the Group I subjects deteriorated more toward the end of the study than Group II subjects, however, post-hoc t-tests showed no significant difference in tracking performance between the groups in any 6-hour period. An analysis based on 30 hours of performance, thus, with fewer dropouts,

gave similar results.

In order to determine if performance deterioration was related to the occurrence of psychological events, the mean of the performance scores for the hours immediately before and after the hour during which each event occurred was computed. This mean value was then subtracted from the mean value of the performance score for that hour during which the event occurred to obtain a difference score. For subjects who had several events at different hours during the 42 hours of testing, the mean of the several difference scores was computed for that subject. Combining all subjects, there were no significant differences in performance between the hours when psychological events occurred and the immediate surrounding hours. Also, overall, subjects who experienced events did not perform significantly differently from subjects with no events in terms of mean performance scores.

## Intercorrelations of Performance and Subjective Ratings

Considering the intercorrelations of the 10-minute subjective ratings with performance, it was notable that subjective sleepiness was inversely related to performance for tracking ($r=-0.13$), pattern recognition ($r=-0.31$), and addition ($r=-0.47$). Attention/fantasy was positively related ($r=.08$, .19, and .26, respectively). All of these correlations, though small, were significant ($p<.05$). Restroom trips were correlated -0.17 with tracking, but apart from this, restroom trips, eating, and drinking had negligible relationships to performance. Subjects and experimenters had only moderate agreement on mental content rankings ($r=0.67$), and the means of these rankings were poorly correlated with the attention-fantasy visual analog scale ($r=0.28$). The mean mental content rankings had only negligible correlations to performance.

## DISCUSSION

A major focus of this work was upon whether the psychological events and performance deterioration which accompany sustained continuous performance could be eliminated or reduced by allowing subjects to work in pairs. If our sustained performance paradigm is a valid model for modern-day emergency situations which a computer-console operator may face, this issue has considerable practical importance. Some subjects who had experienced waking dream-like states or illusions while awake said they were abruptly re-oriented to their surroundings when the other subject made a comment which did not fit into the dream or illusion. This gives some anecdotal support for the hypothesis that enhanced social contact could help prevent the occurrence of psychological disturbances. Nevertheless, while the proportion of subjects with psychological events and dropouts was somewhat higher in our Group I subjects who worked alone as compared to Group II subjects working in pairs, these differences were not significant.

It appears that sustained performance rather than isolation was the main factor in the deterioration which occurred. There were no group differences in overall performance, though the one significant interaction effect provided minor evidence that the Group I subjects deteriorated more in tracking performance. When so many significance tests were computed, a single difference at the .05 level should not receive great emphasis. Had rather large numbers of subjects been studied, the differences between groups might have reached statistical significance, but social contacts clearly had no profound influence either favorable or unfavorable on the performance of these subjects.

Despite minor differences in the protocols, the performance deteriorations noted among these current subjects were very similar to those described in our previous study (Mullaney, Kripke, and Fleck, 1981). As in the previous study,

there were trends for performance to deteriorate during the usual hours of sleep (ie, about midnight-6:00 AM) and progressively over the 42 hours. On the other hand, we were surprised that the unusual psychological events occurred in quite a scattered fashion. Although many of the psychological events had a distinct dreamlike quality like a waking dream, they were not highly concentrated either during the usual hours of dreaming or at the end of the experiment. Since the pattern of occurrence of these events was different from the pattern of deterioration of performance, and since we could demonstrate no temporal or across-subject associations, we reach the surprising conclusion that these unusual psychological events had rather little relationship to performance deterioration.

In conclusion, this study confirmed our previous finding that performance deteriorates rapidly when subjects are required to sustain continuous attention. Although working with another person might be of some mild benefit and the precipitation of psychological disturbances may play some role, the main factor seems to be an inability of even highly-motivated subjects to sustain tasks which require such unremitting attention and performance. The striking improvement which we found in subjects just a few minutes after they were relieved of their duties indicates to us that it is the lack of rest breaks which is the major factor involved in producing the performance deterioration observed.

## References

Mullaney, D.J., Kripke, D.F., & Fleck, P. Sleep loss effects on continuous sustained performance. Navy Technical Report No. 1, AD#A098682. Alexandria, VA: Defense Technical Information Center, April, 1981.

Rechtschaffen, A. and Kales, A. Manual of Standard Terminology, Techniques and Scoring System for Sleep Stages of Human Subjects. Los Angeles: Brain Information Service/ Brain Research Institute, UCLA, 1968.

Table 1

Psychological "Events" During Performance Testing

| Group | Type of Disturbance: Confusion & Delusion | Illusions & Distortions | Derealization & Disorientation | Hypnagogic Hallucination | Hallucinations | Number of Subjects with any Symptoms |
|---|---|---|---|---|---|---|
| Alone (N=10) | 3 | 5 | 3 | 1 | 7 | 9 |
| Pairs (N=20) | 0 | 8 | 1 | 0 | 9 | 13 |

Table 2

Psychological "Events" During Performance Testing.

Data from 10 subjects from a previous 42-hour sustained performance study who worked alone were combined with data from the 10 subjects in this study.

| | Type of Disturbance | | | | | |
|---|---|---|---|---|---|---|
| Group | Confusion & Delusion | Illusions & Distortions | Derealization & Disorientation | Hypnagogic Hallucination | Hallucinations | Number of Subjects with any Symptoms |
| Alone (N=20) | 3 | 12 | 8 | 2 | 10 | 17 |
| Pairs (N=20) | 0 | 8 | 1 | 0 | 9 | 13 |

Table 3

Sources of Variance and F-ratios

Comparing 10 Subjects Working Alone with 20 Working in Pairs

| | F Ratios and Significance Levels | |
|---|---|---|
| Data | Time Main Effect | Time/Group Interaction |
| Tracking | 10.22 ($p < .0001$) | 2.50 ($p < .05$) |
| Pattern Memory | 26.58 ($p < .0001$) | ns |
| Addition | 75.81 ($p < .0001$) | ns |
| Sleepiness | 39.06 ($p < .0001$) | ns |
| Attention/Fantasy | 11.82 ($p < .0001$) | ns |
| Feeding | ns | ns |
| Drinking | 3.61 ($p < .005$) | ns |
| Restroom Trips | ns | ns |
| Mean Card Ranking | 2.48 ($p < .05$) | ns |

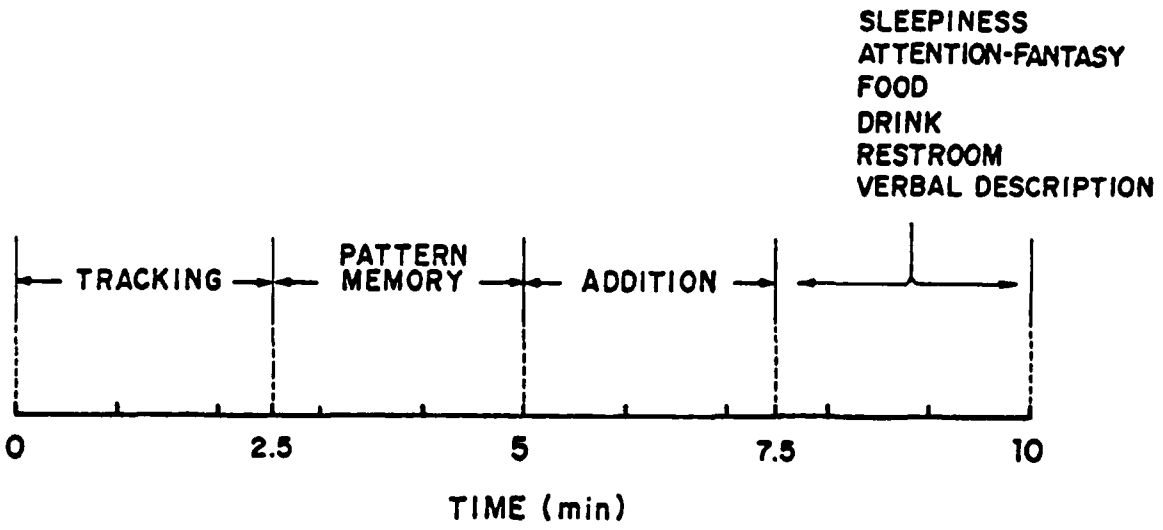



Fig. 1. 10-minute sequence of task presentation.

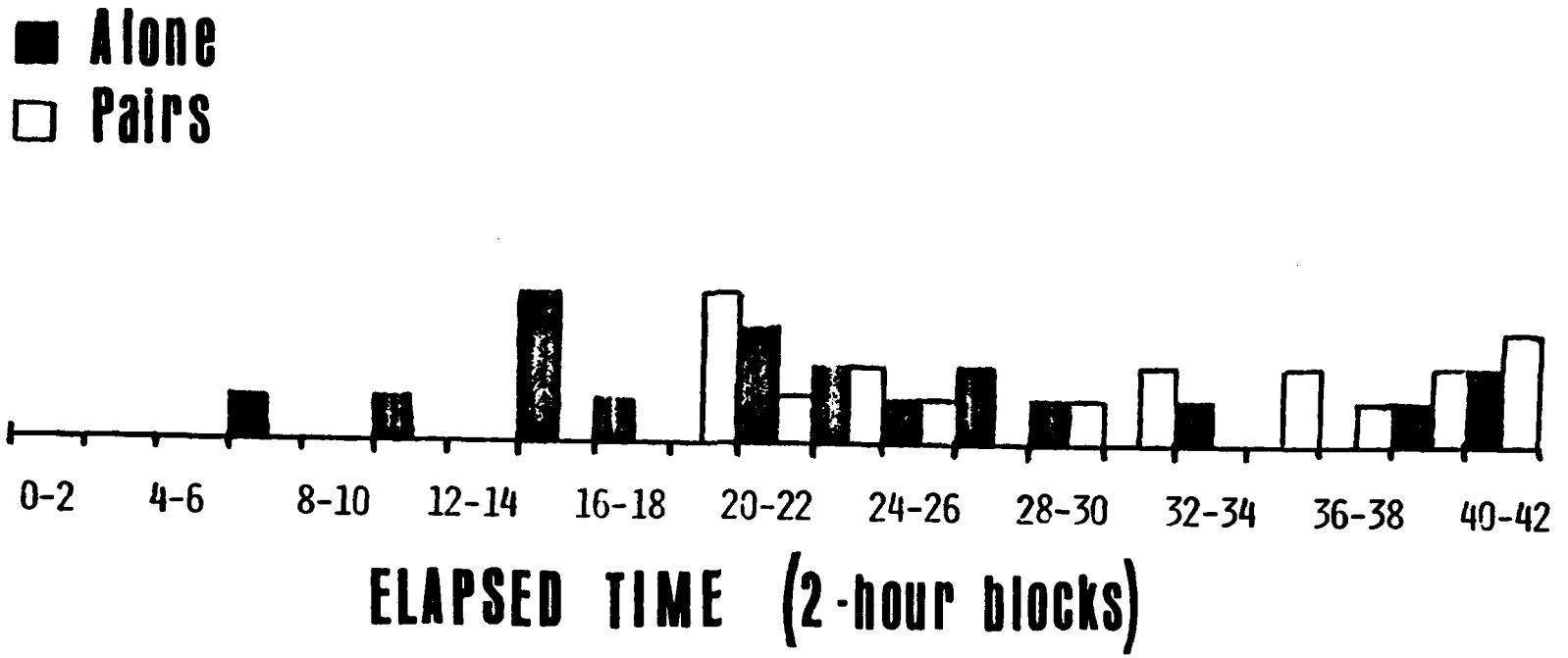



Fig. 2. Histogram Displaying Times at which Psychological "Events" Occurred.

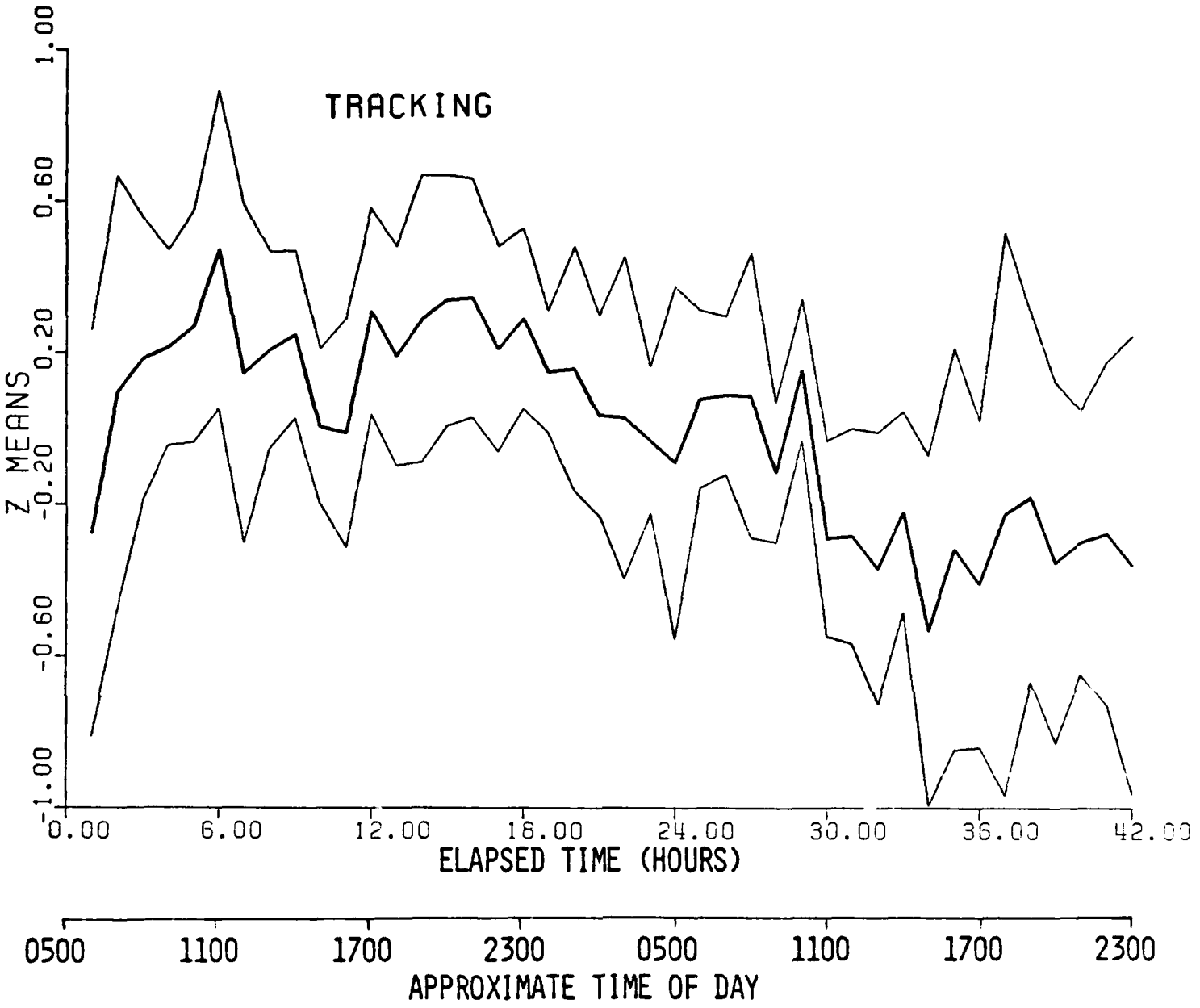



Fig. 3a. Hourly means of normalized tracking performance for the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

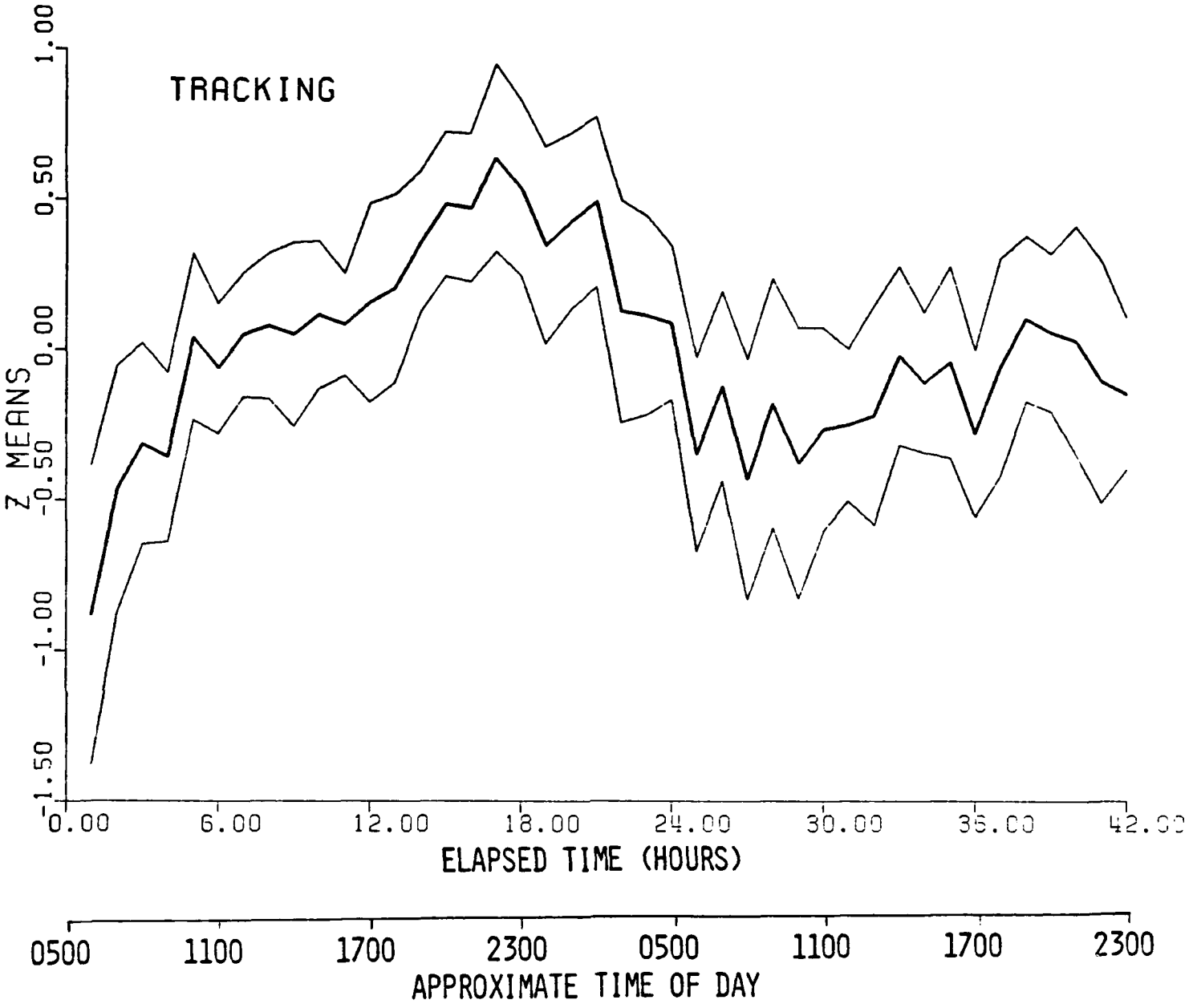



Fig. 3b. Hourly means of normalized tracking performance for the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

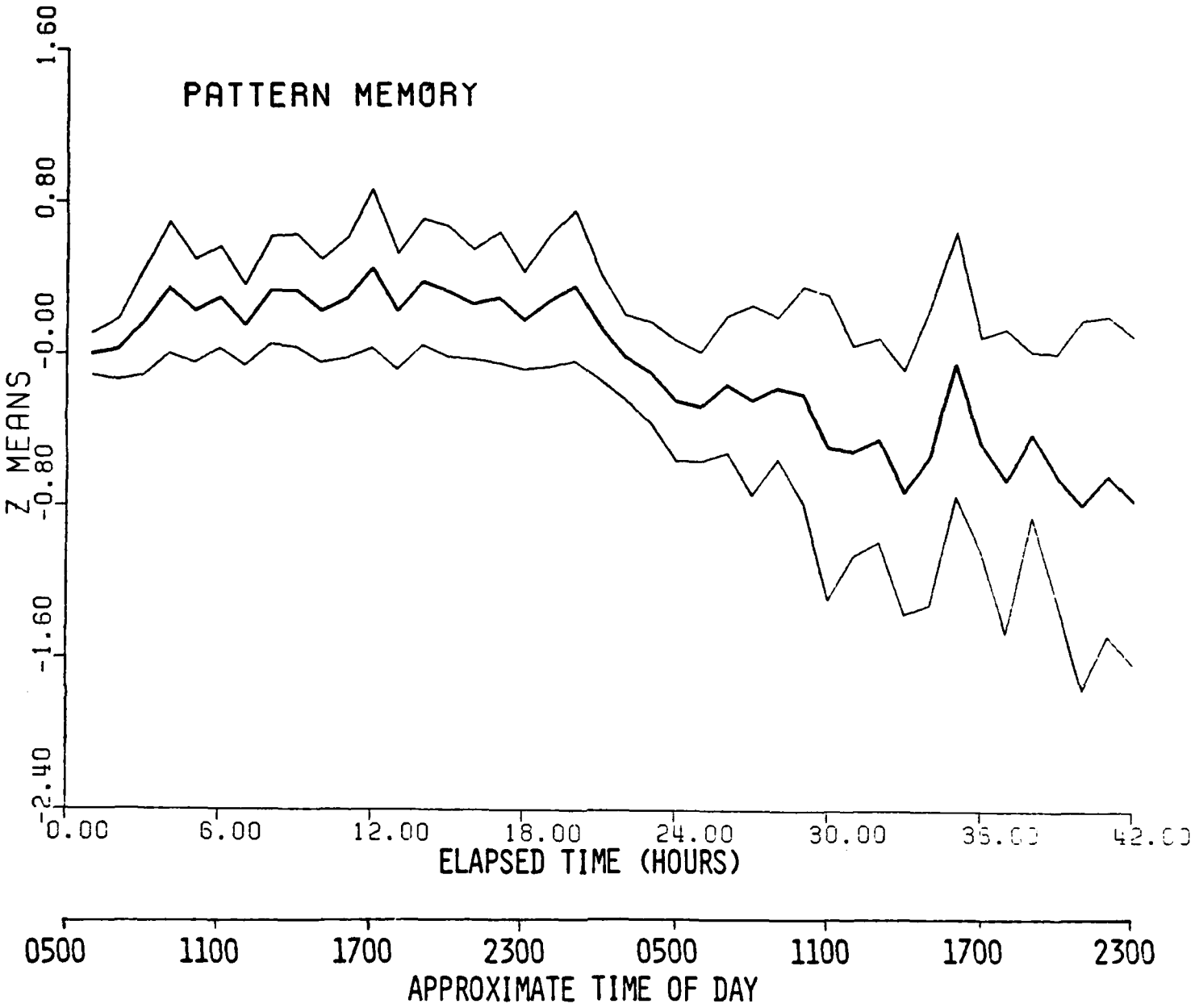



Fig. 4a. Hourly means of normalized pattern memory performance for the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

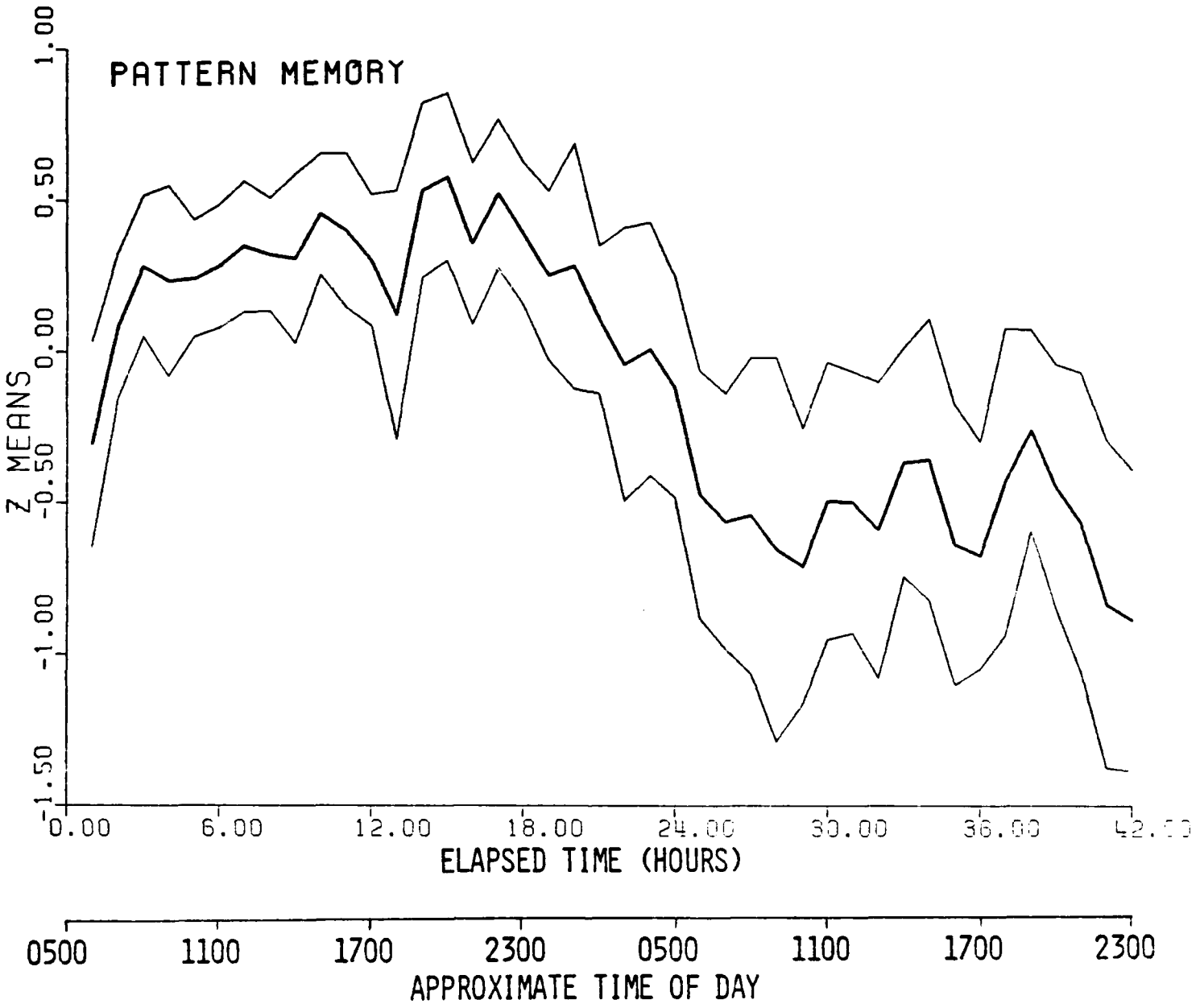



Fig. 4b. Hourly means of normalized pattern memory performance for the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

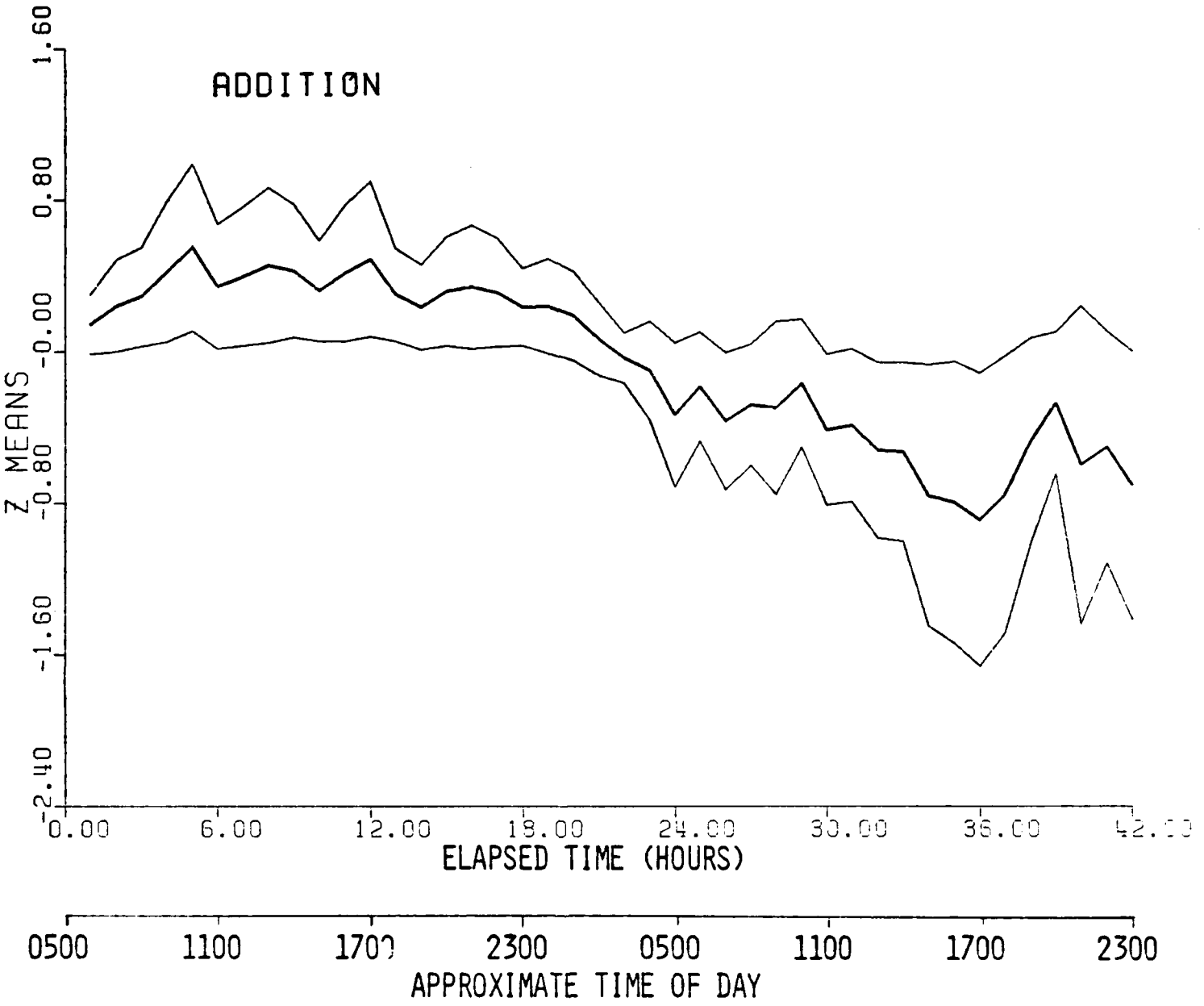



Fig. 5a. Hourly means of normalized addition performance for the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

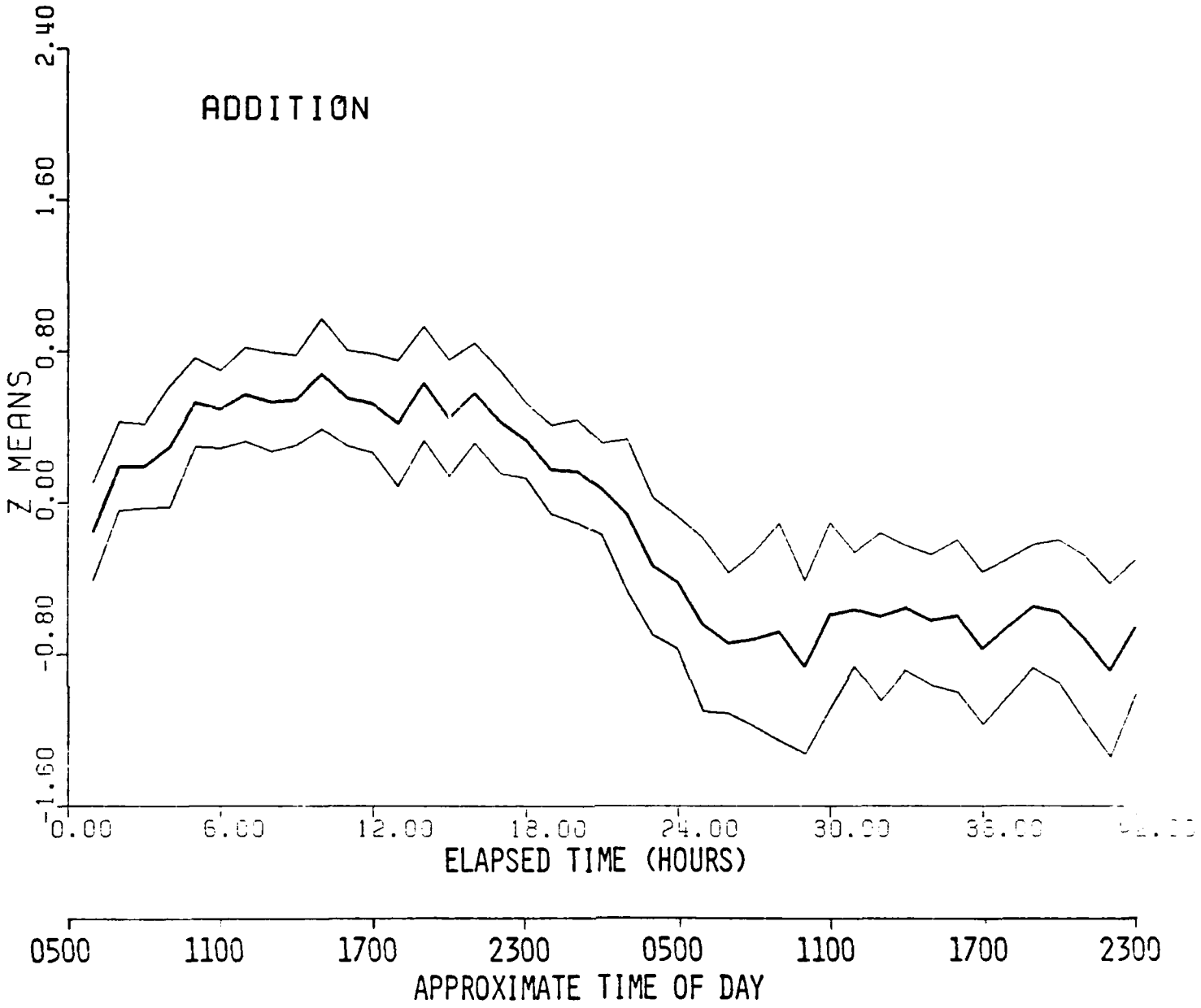



Fig. 5b. Hourly means of normalized addition performance for the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

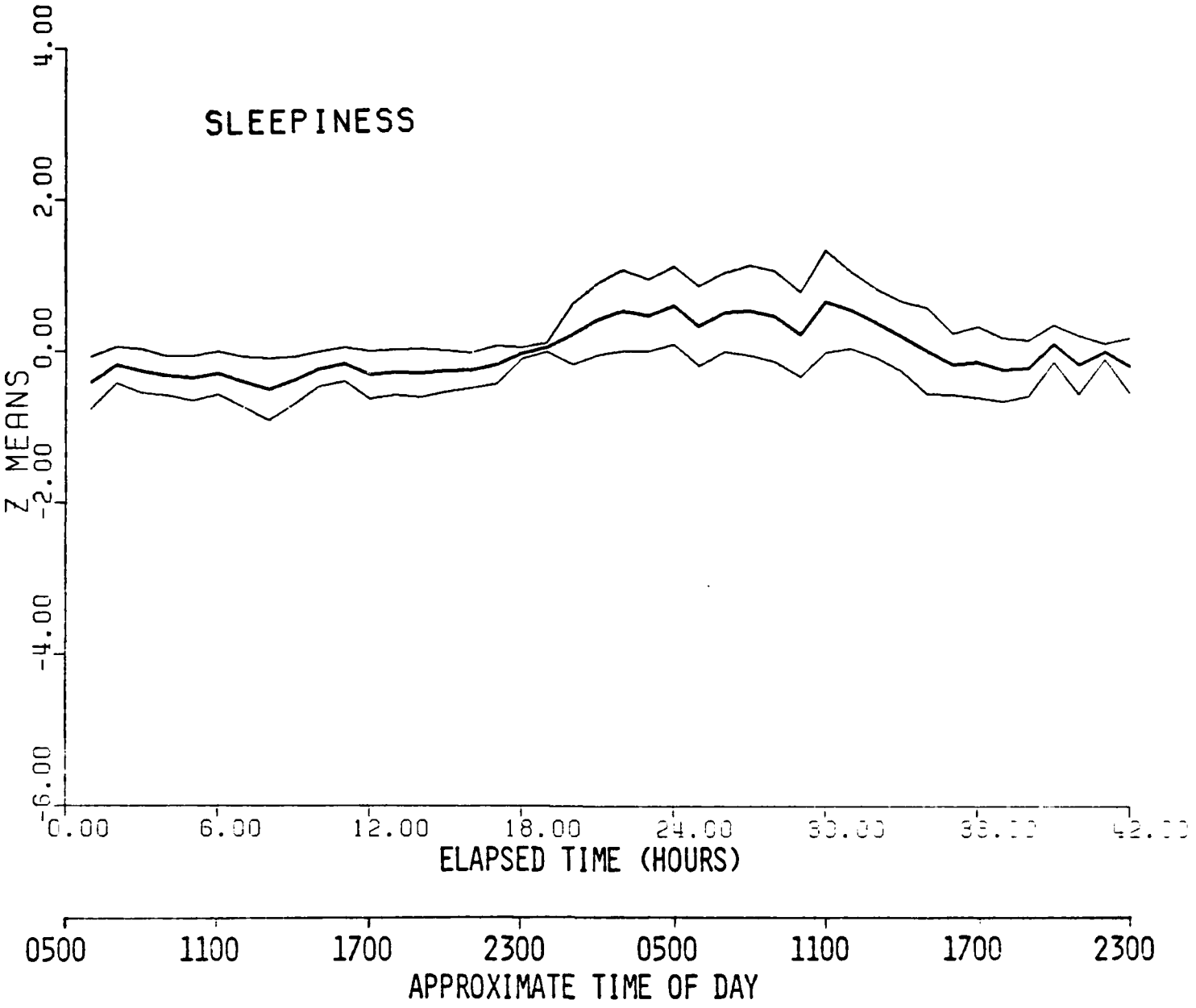



Fig. 6a. Hourly means of normalized subjective sleepiness for the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

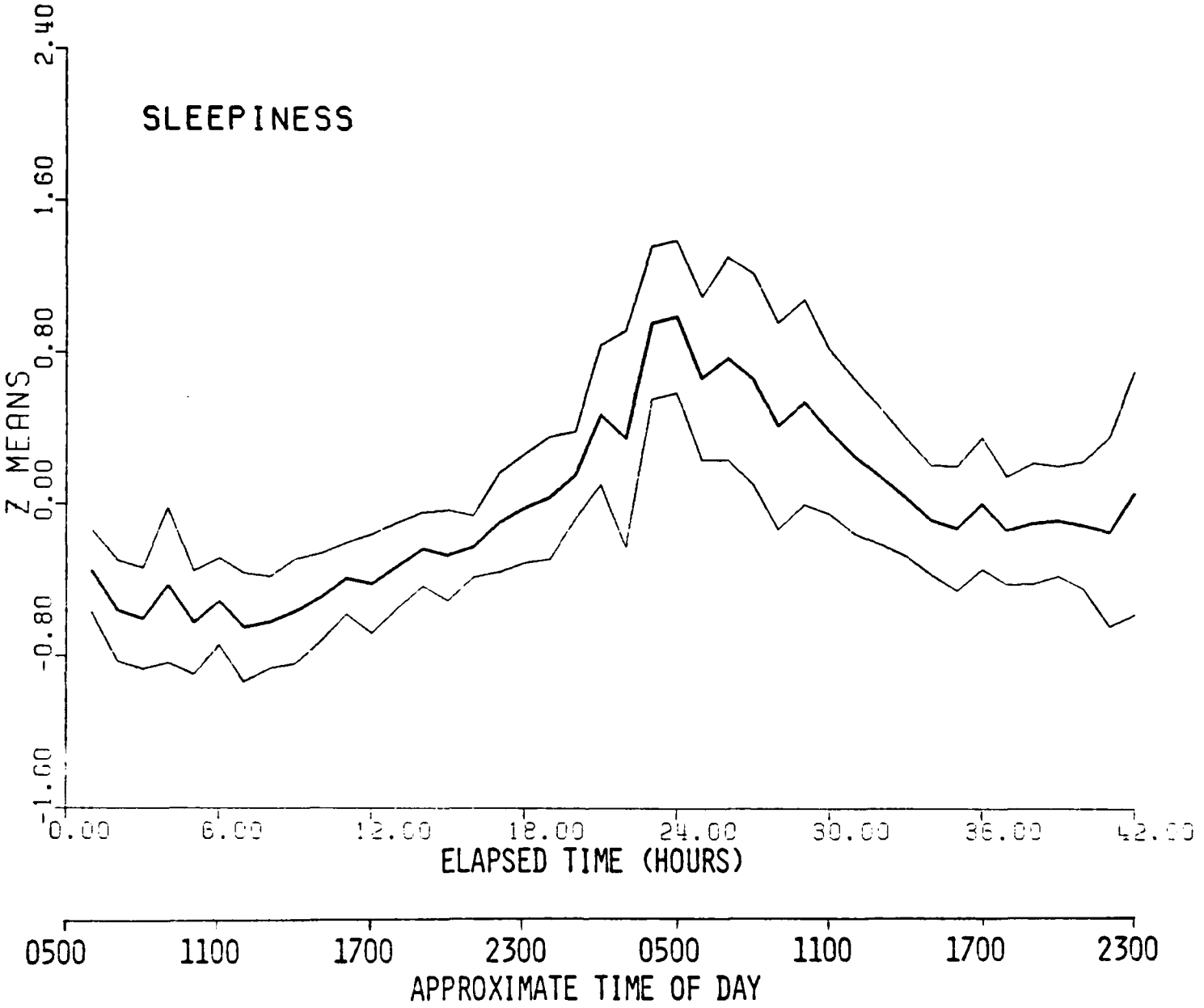



Fig. 6b. Hourly means of normalized subjective sleepiness for the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

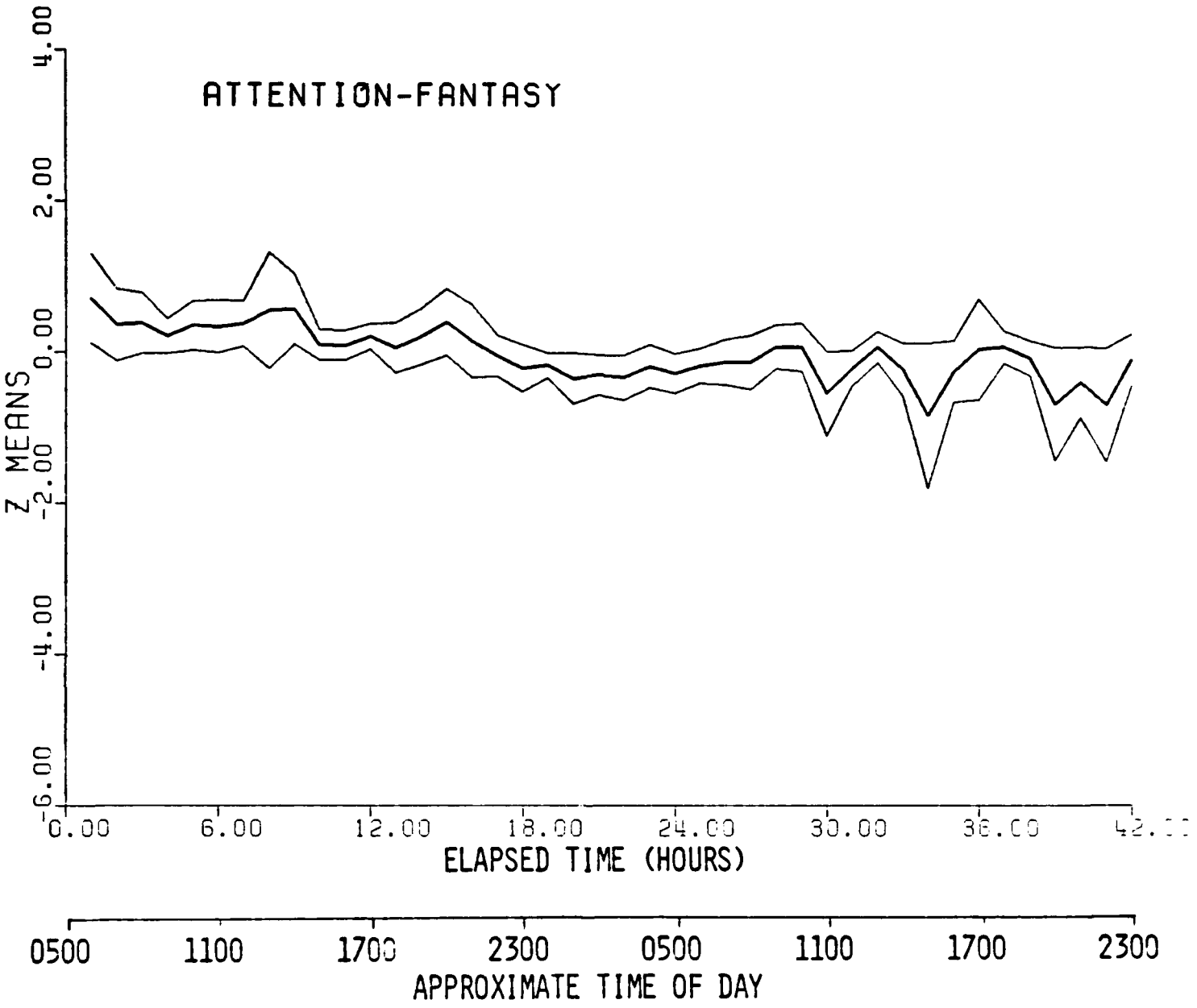



Fig. 7a. Hourly means of normalized attention-fantasy scale estimates for the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

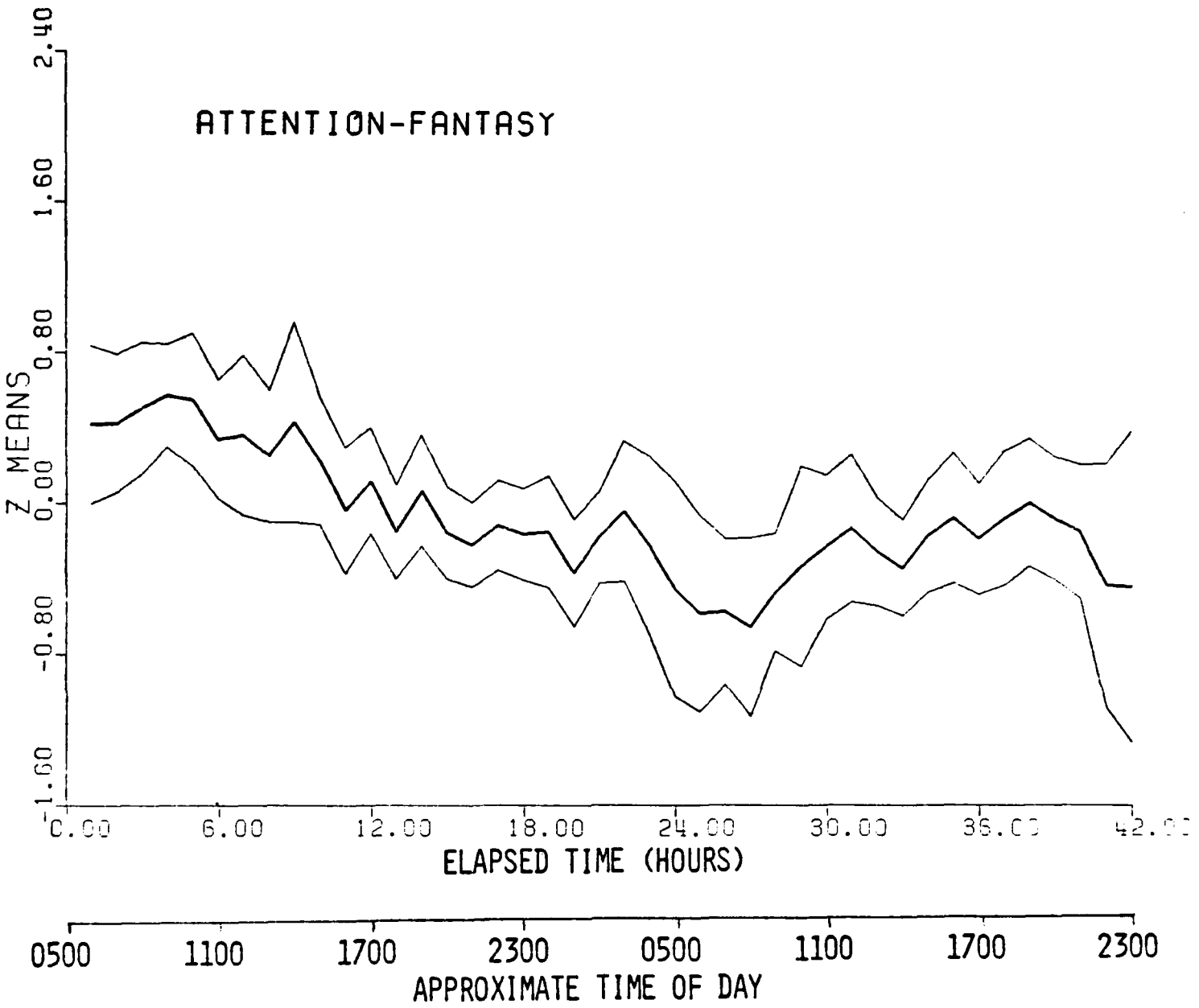



Fig. 7b. Hourly means of normalized attention-fantasy scale estimates for subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

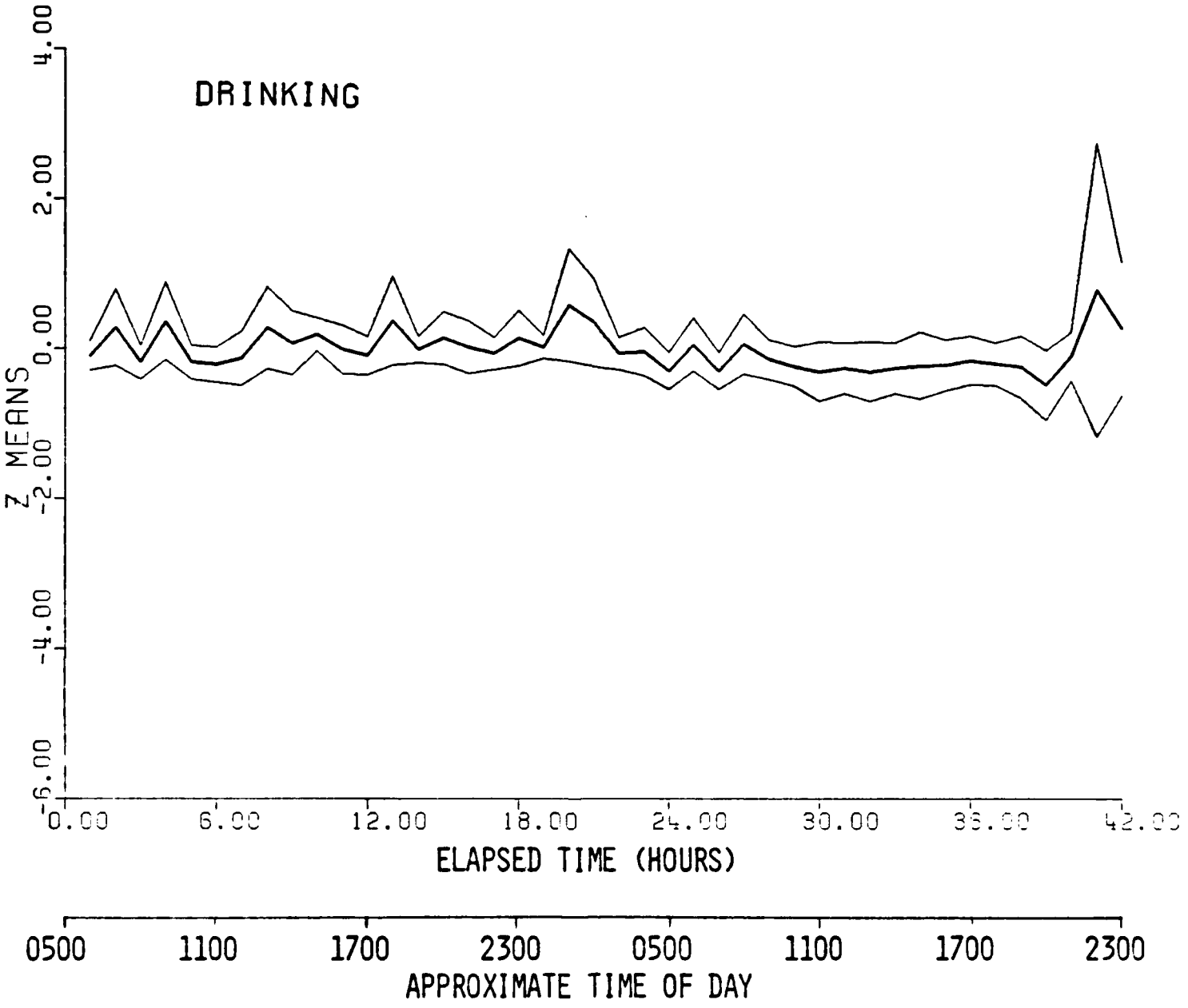



Fig. 8a. Hourly means of normalized numbers of drinks consumed by the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

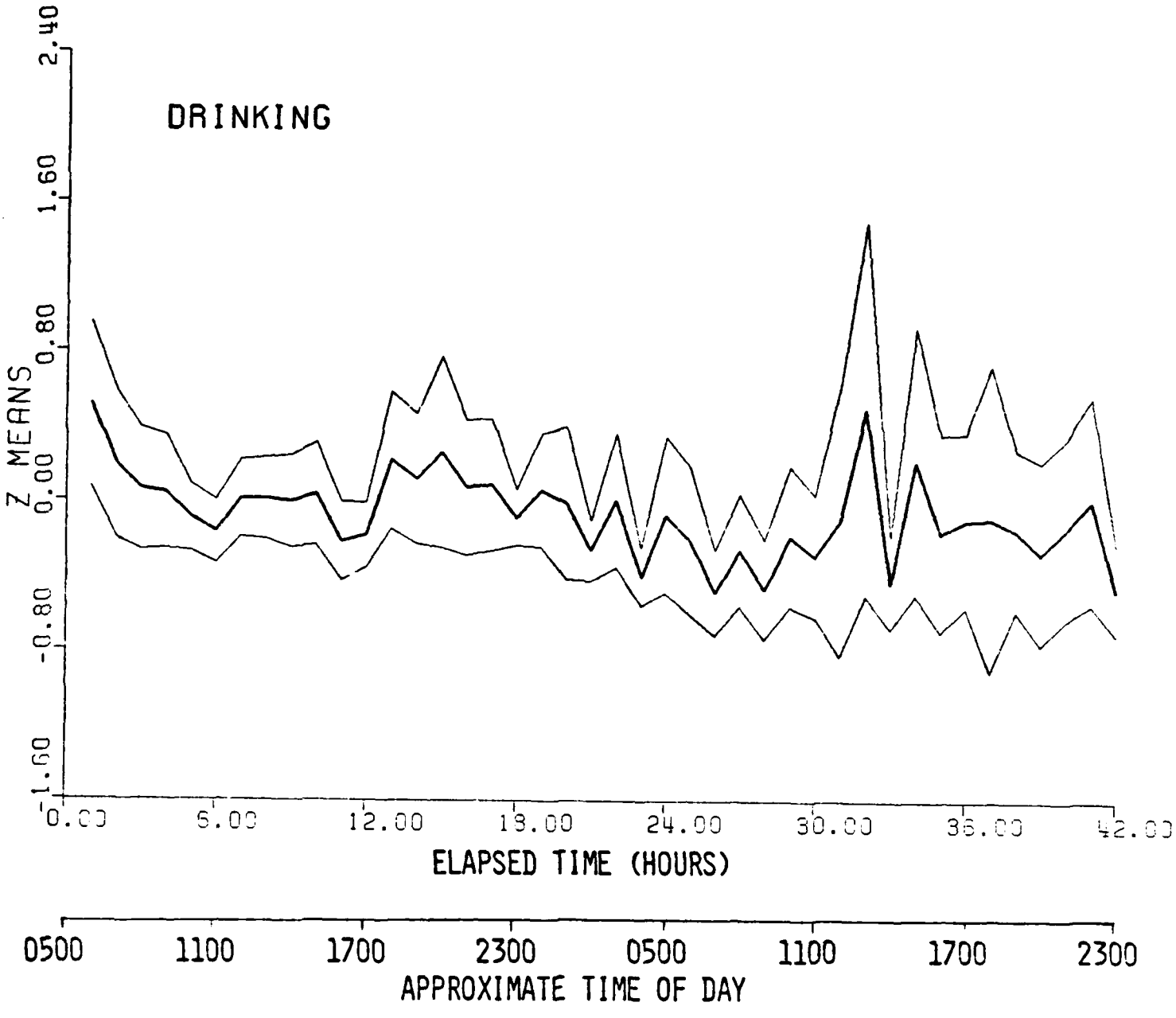



Fig. 8b. Hourly means of normalized numbers of drinks consumed by the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

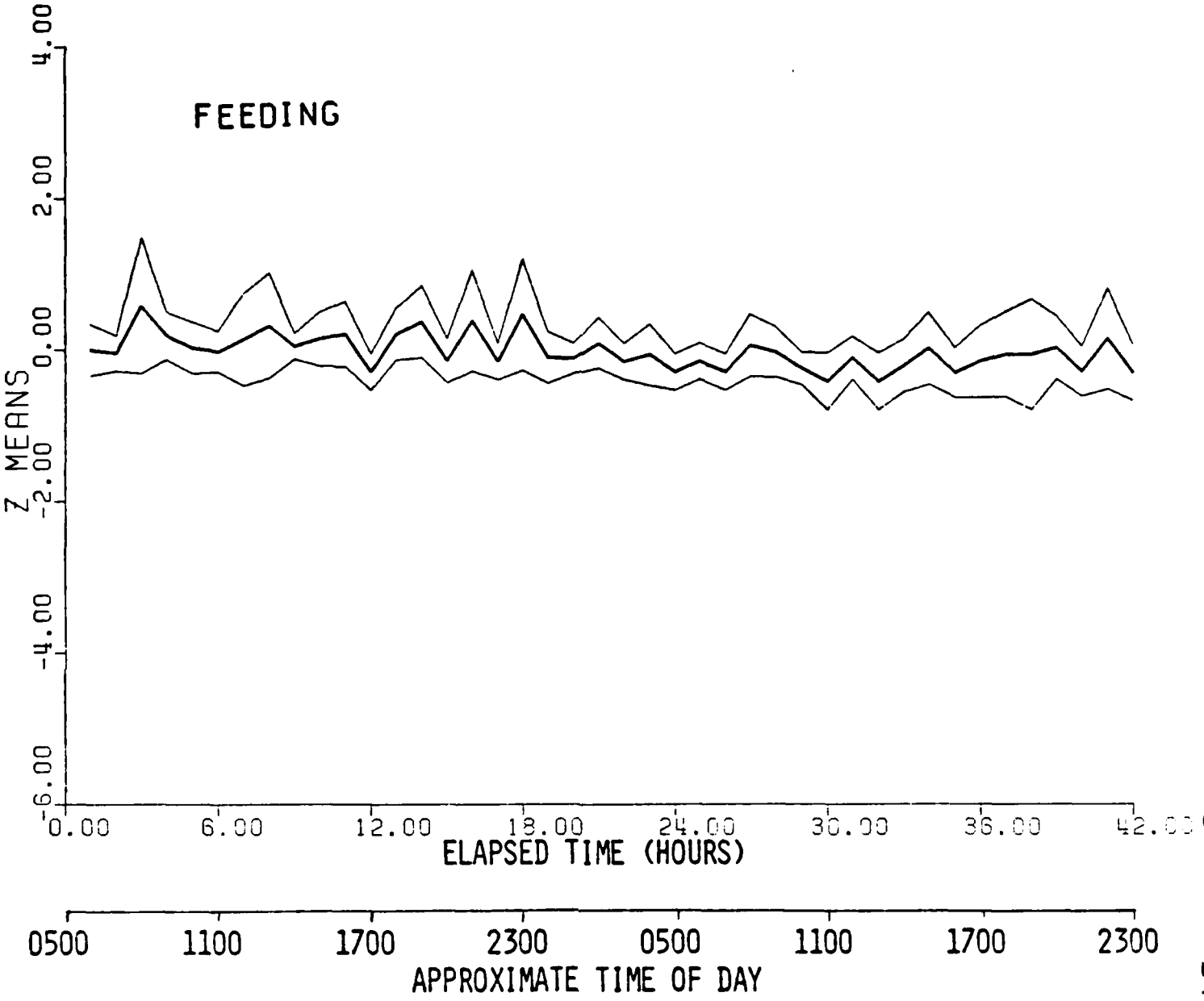



Fig. 9a. Hourly means of normalized subjective estimates of feeding by the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

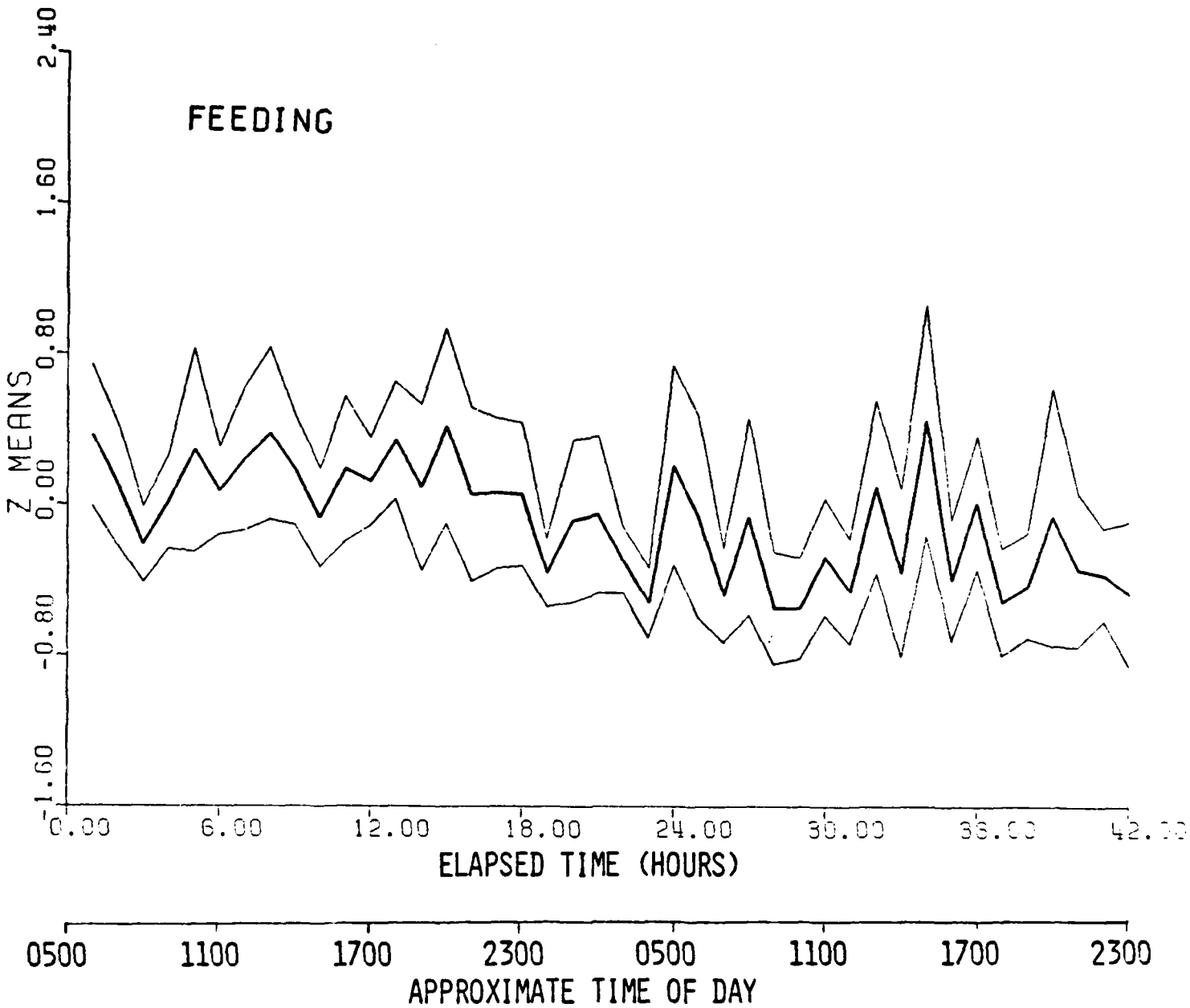



Fig. 9b. Hourly means of normalized subjective estimates of feeding by the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

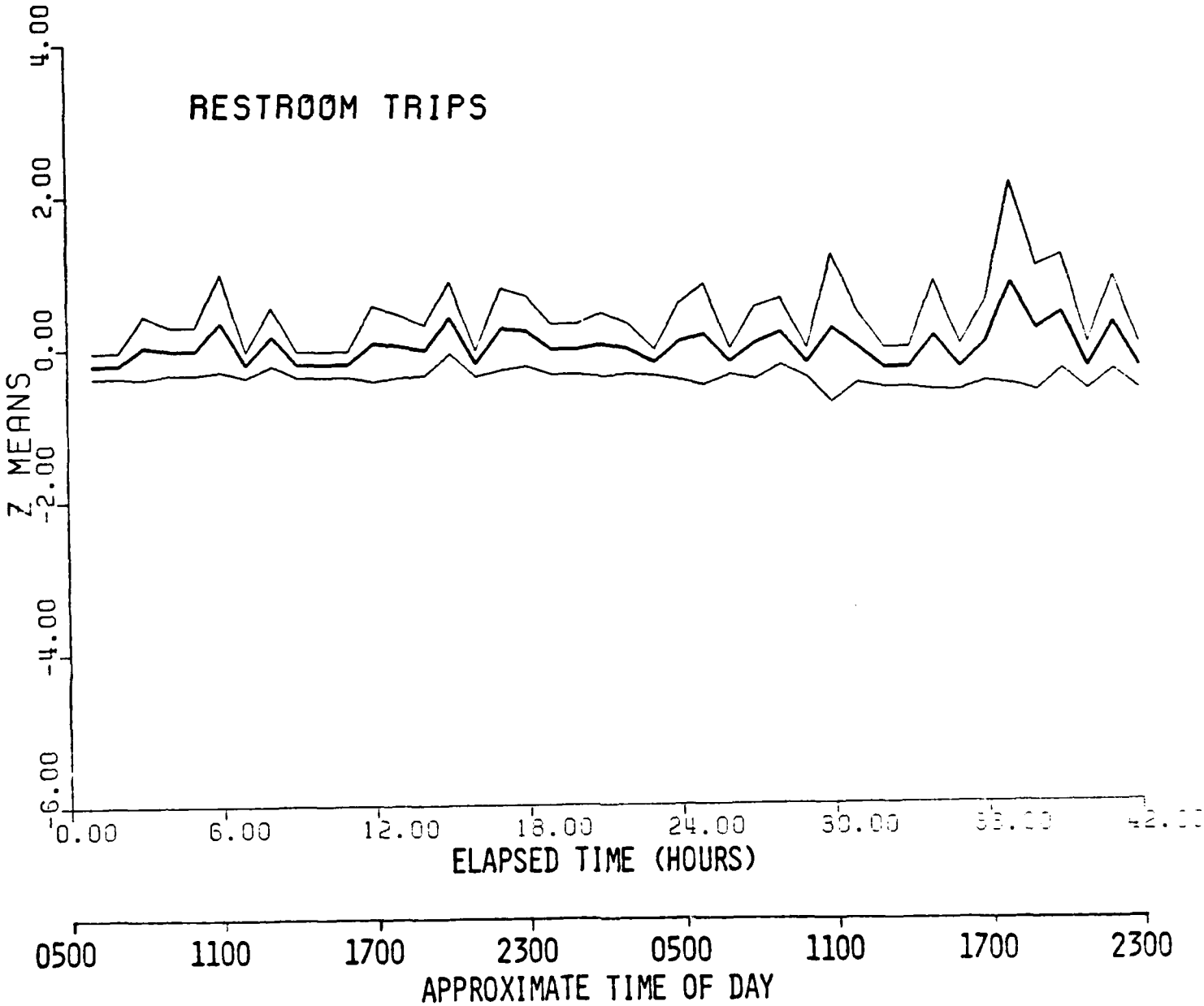



Fig. 10a. Hourly means of normalized numbers of restroom trips taken by the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

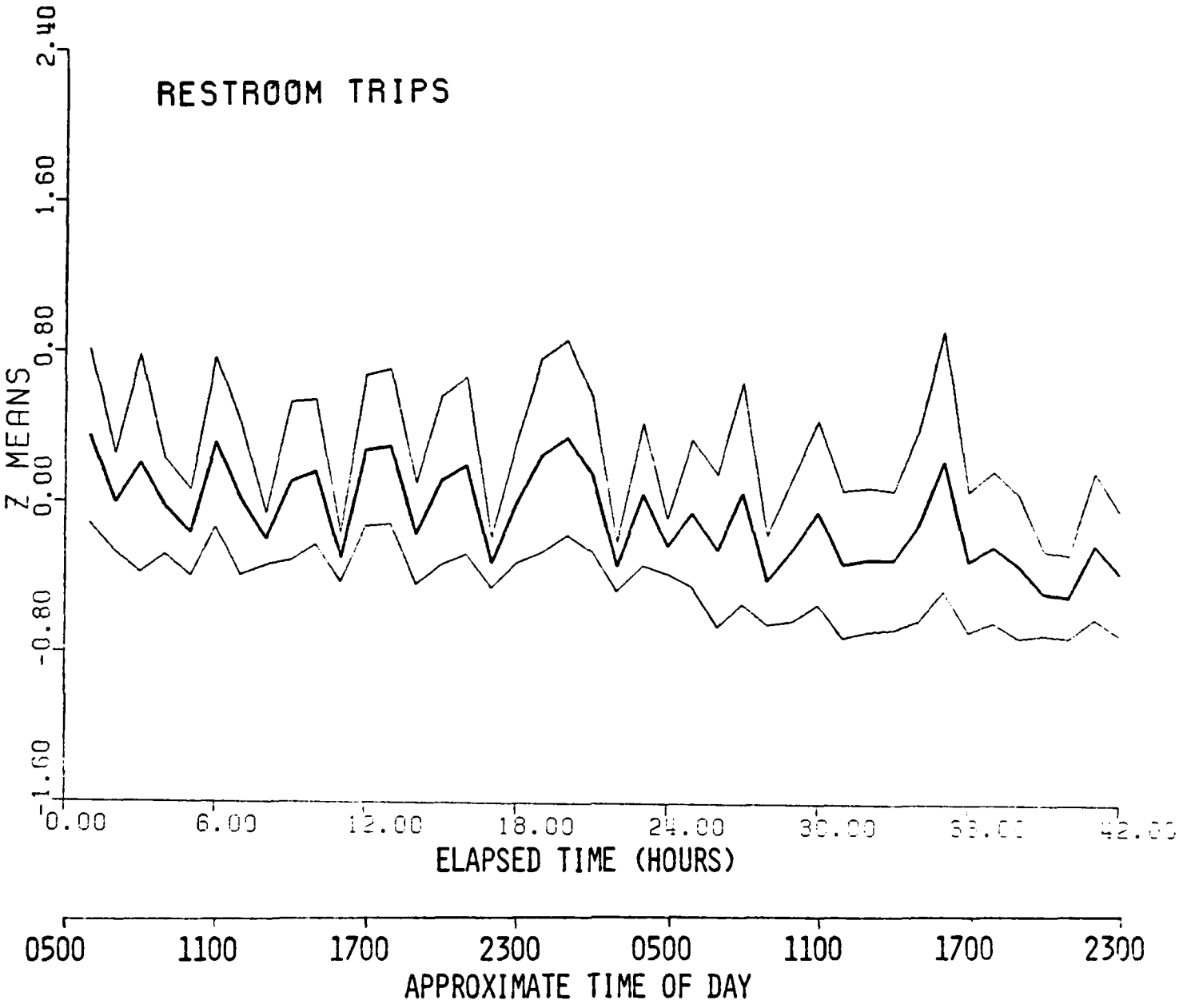



Fig 10b. Hourly means of normalized numbers of restroom trips taken by the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

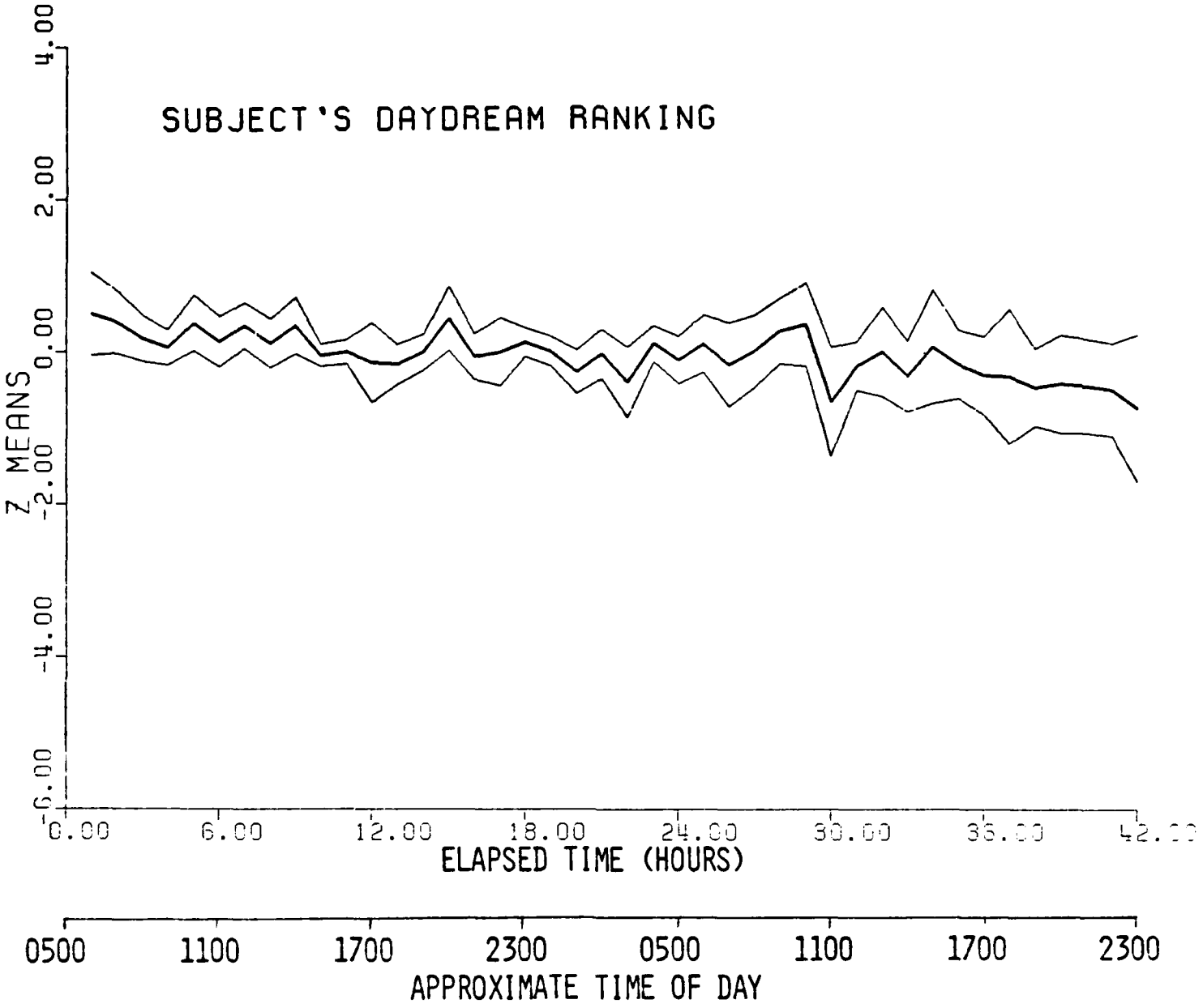



Fig 11a. Hourly means of normalized card rankings by the subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

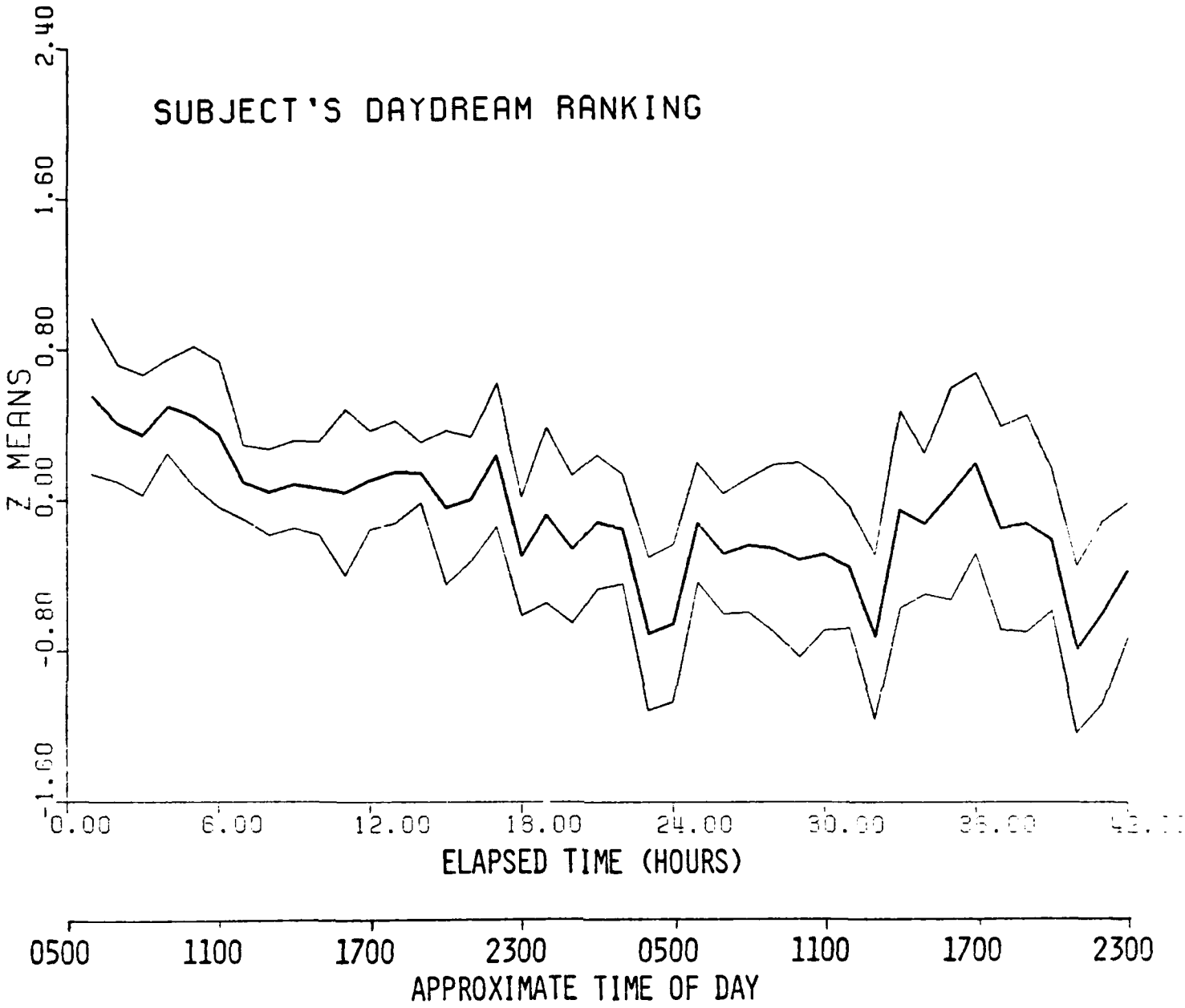



Fig. 11b. Hourly means of normalized card rankings by the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

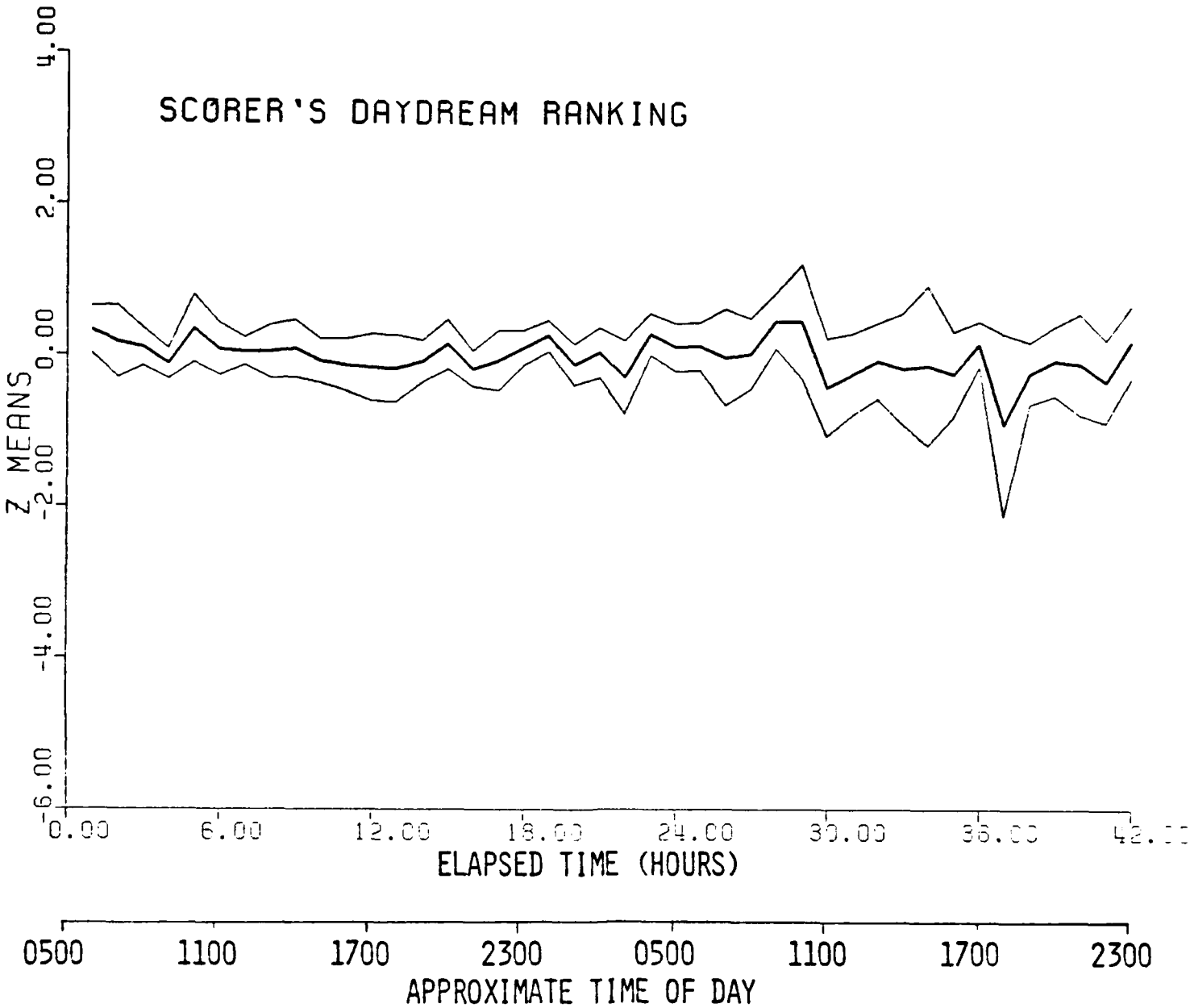



Fig. 12a. Hourly means of normalized card rankings by the scorer for subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

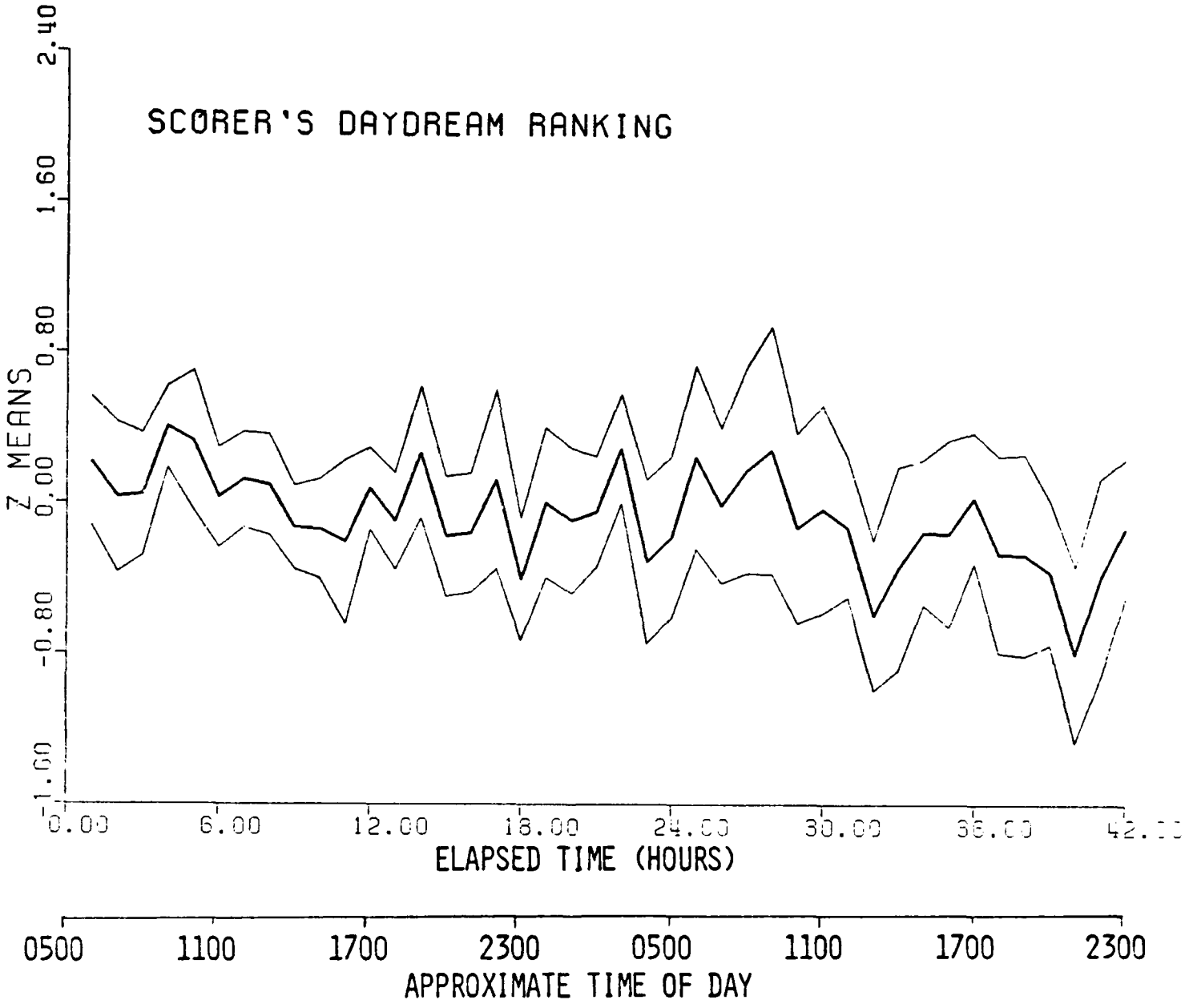



Fig. 12b. Hourly means of normalized card rankings by the scorer for subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

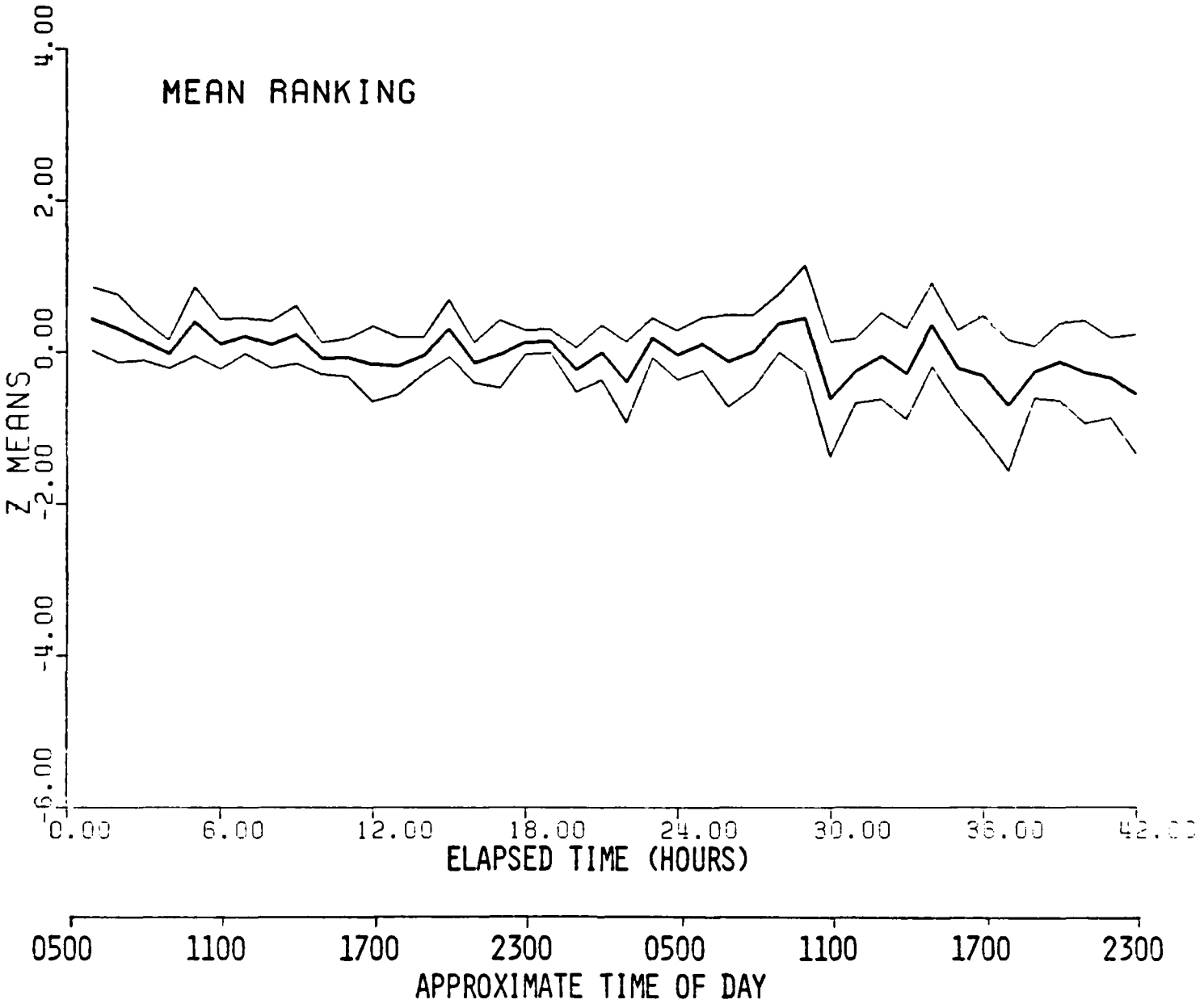



Fig. 13a. Hourly means of normalized arithmetic averages of subjects' and scorer's card rankings for subjects who worked alone (N=10). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

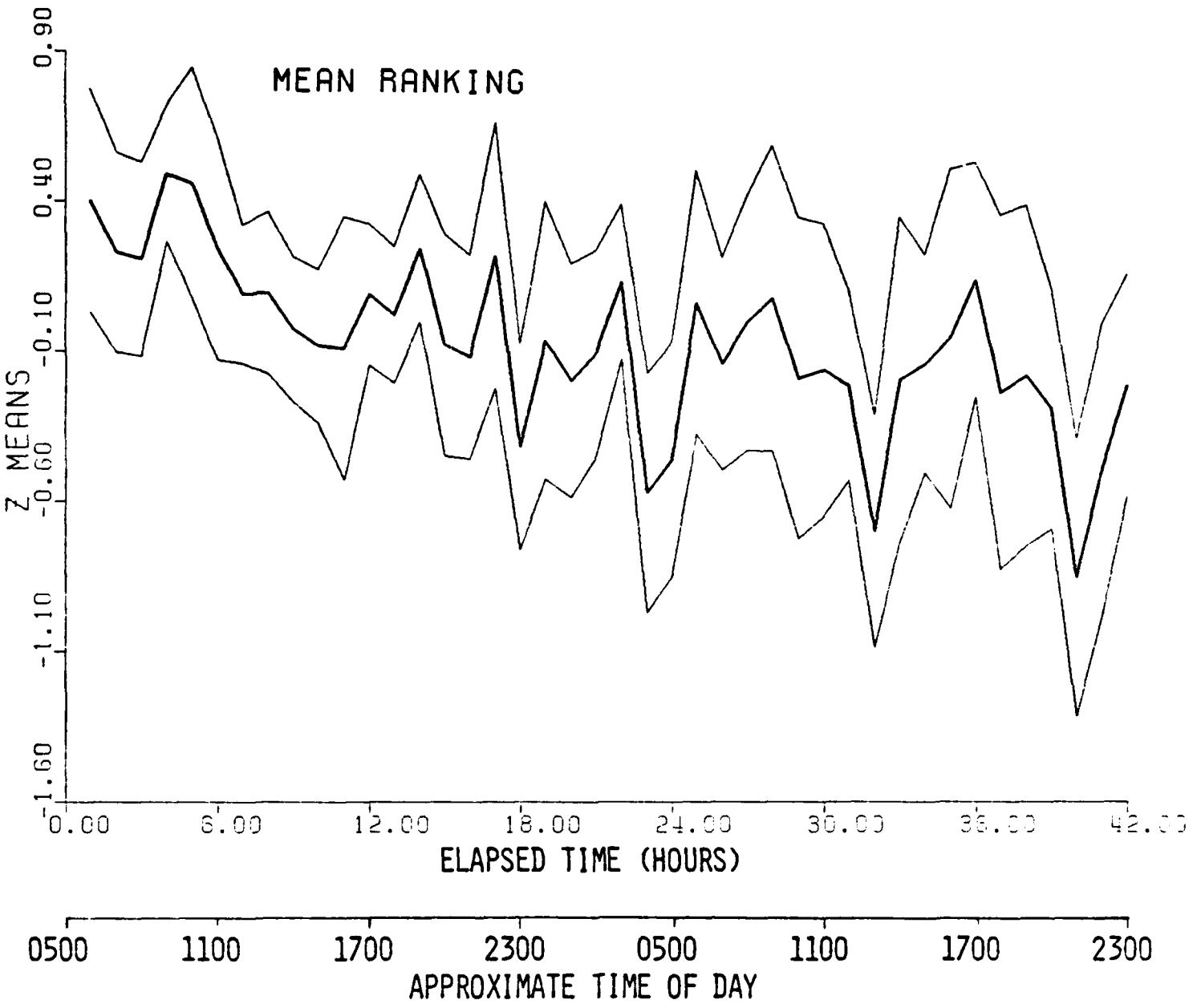



Fig. 13b. Hourly means of normalized arithmetic averages of subjects' and scorer's card rankings for the subjects who worked in pairs (N=20). Means were derived from z-scores for the entire data of each subject. Also plotted are 95% confidence limits.

APPENDIX A

## SUBJECT INSTRUCTIONS

In this study, subjects are needed who feel willing and able to accurately describe their thought content and daydreams. Although there are no doubt many people who regard their inner thoughts a very private matter, this experiment requires volunteers who will freely describe that which goes on inside their minds for 42 hours.

We are particularly interested in knowing whether the thoughts which occur in each 10-minute period are more like daydreams or more like thinking or alert perception. Accordingly, subjects will have to write out a short but vivid and representative description of their thoughts each and every 10 minutes.

Each subject will be asked to return a day or two after the experiment or as soon as possible thereafter to rate his cards, which will have been placed in random order. We would like you to carefully rank the cards from the most dreamlike to the least dreamlike. Below are some descriptions which may assist you in ranking the cards:

| | |
|---|---|
| Very Dreamlike: | Unreal dreamlike fantasies, especially vividly imagined, with bizarre, illogical, or symbolic elements, especially having content related to love, sex, fear, anger, hunger, wishes or other strong emotions. Like night dreams, these tend to be in the past or future but unconnected with the present circumstances. |
| | Abstract and fanciful thinking about the past or planning for the future, but not logical or realistic. Accompanied by feelings. |
| | Realistic logical thinking and planning, especially for the immediate future, or consideration of the immediate past, with less feeling. |
| | Thinking that is practical, logical, concrete, realistic, and associated with present circumstances, e.g., the experiment. Present time thinking or planning. |
| | Perception. Looking around and hearing actual sounds, associated with thought. |
| Very Un-dreamlike: | Predominantly present-time sensory awareness, or perceptual-motor activity, e.g., some physical activity that is very involving, at a motor level. |

Please write 2 to 3 sentences (30-40 words) legibly describing what has been on your mind. Writing "no change since the last card", etc. is useless since we will shuffle the cards before they are ranked. It is helpful if you will look again at the screen after writing each description to check the number and then write the number a second time on the card.

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